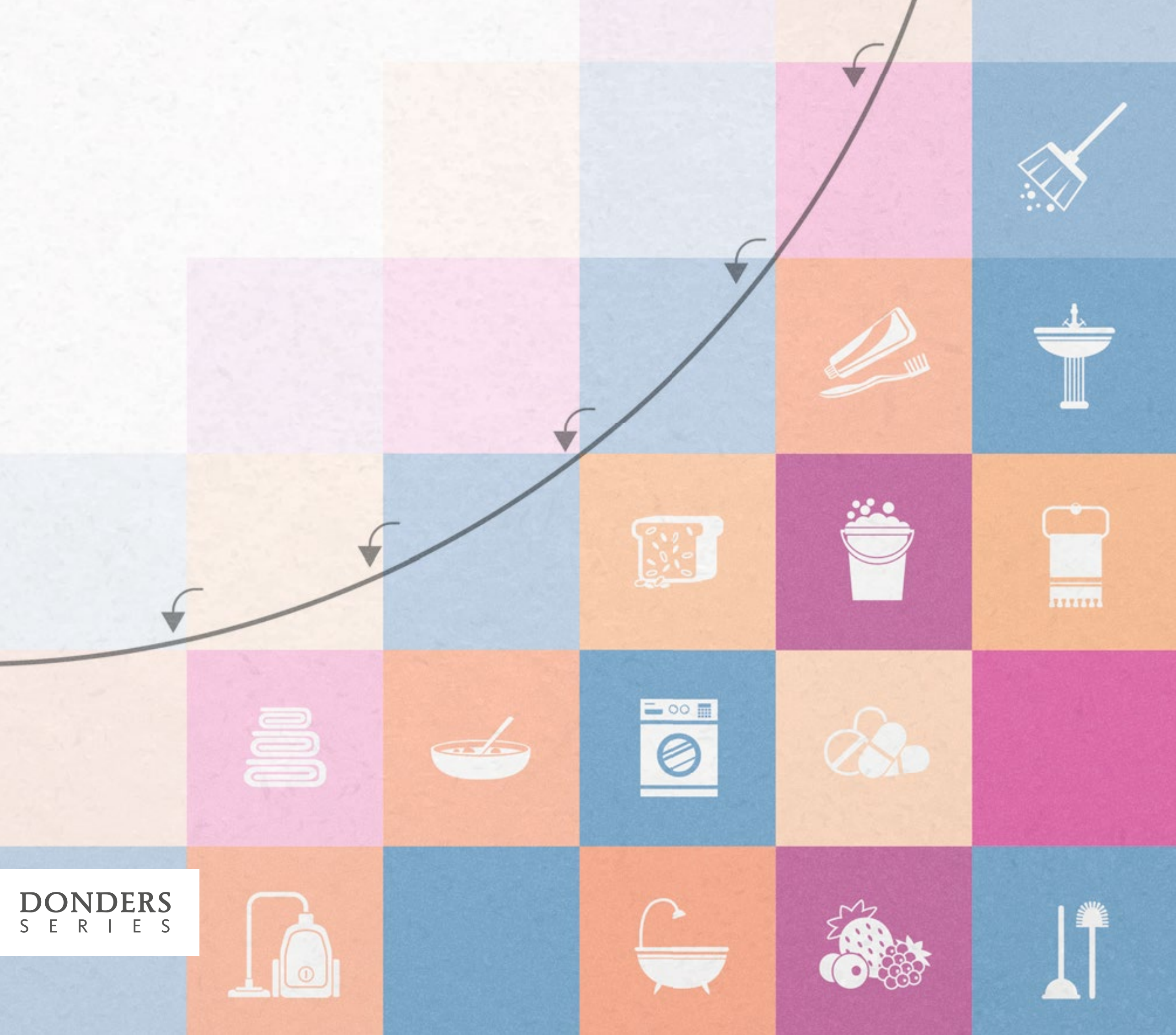
Errorless learning in dementia

Maartje de Werd



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Maartje Maria Elisabeth de Werd

The studies described in this thesis were funded in part by the Devon Foundation and the NutsOhra Foundation (grant #1301-019). The REDALI-DEM study was funded by the German Research Foundation (Reference Number: HU 778/3-1).

ISBN
978-94-6284-110-9

Design/lay-out
Promotie In Zicht, Arnhem

Print
Ipskamp Printing, Enschede

Errorless learning in dementia

Proefschrift

ter verkrijging van de graad van doctor
aan de Radboud Universiteit Nijmegen
op gezag van de rector magnificus prof. dr. J.H.J.M. van Krieken,
volgens besluit van het college van decanen
in het openbaar te verdedigen op
donderdag 1 juni 2017
om 12:30 uur precies

door

Maartje Maria Elisabeth de Werd
geboren op 8 juni 1986
te Vlijmen

Promotoren
Prof. dr. R.P.C. Kessels
Prof. dr. M.G.M. Olde Rikkert

Copromotor
Dr. D.H.E. Boelen (Klimmendaal)

Manuscriptcommissie
Prof. dr. R.T.C.M. Koopmans (Voorzitter)
Dr. M.J.L. Graff
Prof. dr. C.M. van Heugten (Universiteit Maastricht)

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1 General introduction

This chapter is based on:

de Werd, M. M. E., Boelen, D. H. E., & Kessels, R. P. C. (2014). *Errorless learning in dementia: A practical manual* (Ch. 1). Sydney, Australia: ASSBI Resources.

General introduction

Learning and memory

Learning and memory are cognitive functions that are essential for independent living. Without learning abilities we would not be able to acquire new skills or knowledge. Without memory we could not operate in the present, think back about our past or make plans for the future. Learning and memory are closely related concepts. In general, learning refers to the acquisition of a skill or knowledge, while memory is the ability to retaining and remembering past experience. Or as defined by Squire in 1987: 'Learning is the process of acquiring new information, while memory refers to the persistence of learning in a state that can be revealed at a later time'(p.3). In general, memory covers three aspects of information processing, namely:1) encoding information through sensory input, 2) the consolidation of new information to a permanent state (long-term memory) and 3) the retrieval of stored information at any desired moment (Squire & Butters, 1992). A deficit in one or more of these three processes will lead to memory impairment (amnesia).

Memory is not considered to be a unitary function, but can divided into different memory systems (Squire, 1986). Over the years memory research has led to different views about how information is stored in the brain. A well-known taxonomy of memory systems (see figure 1.1) is presented by Squire (2004). In this taxonomy, memory is divided into short-term (STM) and long-term memory (LTM; Atkinson & Shiffrin, 1968). In their Modal Model, Atkinson and Shiffrin (1968) proposed that information comes in through senses (visual, auditory and tactile sense). Subsequently, the information is transferred into STM. STM refers to the capacity to temporarily hold a limited amount of information in a very accessible (i.e., conscious) state (Cowan, 2008). Nowadays, STM is considered as a part of working memory (WM), a cognitive system with a limited capacity that is responsible for the manipulation of information, to connect information to existing knowledge in the LTM (this makes us able to think, read, learn), for coordinating and monitoring a task, to switch and divide attention and to perform multiple tasks (Baddeley & Hitch, 1974). Within WM, Baddeley and Hitch (1974) originally distinguished two slave systems; one for verbal-auditory information (the phonological loop) and one for visual and spatial information (the visuospatial sketchpad). In addition, the central executive was introduced as a flexible supervisory system responsible for the control and regulation of cognitive processes and the two slave systems. In 2000, Baddeley added a fourth component to the model: the episodic buffer (Baddeley, 2000). This component is a third slave system that binds information across domains to form integrated units of visual, spatial, and verbal information with time sequencing (or temporal ordering), such as the memory of a story. The episodic buffer is also assumed to interact closely with LTM (including semantic memory).

LTM refers to all information that is permanently stored and not active in WM. In Squire's model (2004) LTM is divided into explicit and implicit memory (Tulving, 1972). Explicit memory refers to conscious memories of facts (semantic memory) and events

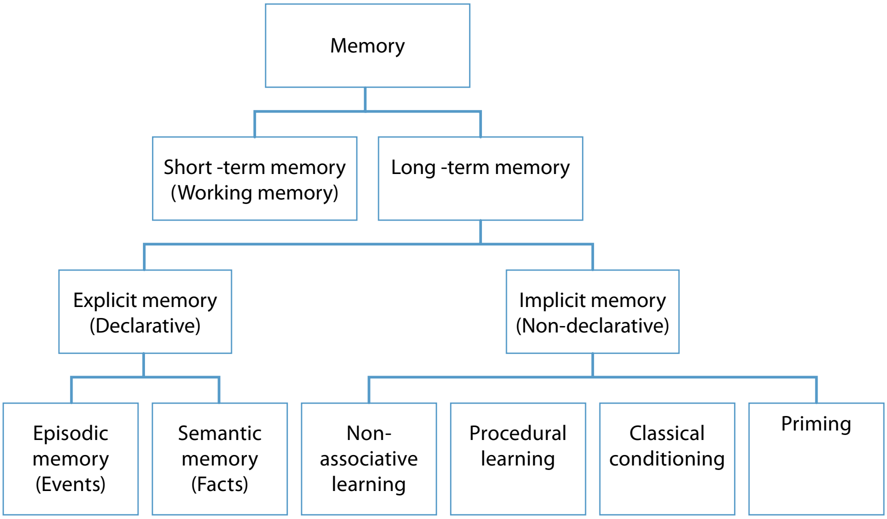

Figure 1.1 Taxonomy of memory systems (adapted from Squire,2004)

(episodic memory; Squire & Butters, 1992). Implicit memory encompasses skills and the possibility of responding in a certain way based on experience, that is, habituation, priming and associative learning. Implicit learning occurs automatically: impressions, experiences and emotions are acquired and stored without conscious awareness.

This distinction between explicit and implicit memory was examined by Brenda Milner in 1962. In her study she examined a patient with a severe anterograde amnesia (patient H.M.), who could not create any new memories. Nevertheless, H.M. proved capable of learning a new motor task, namely mirrored drawing. Despite repeated drawing sessions, H.M. could not explicitly recall any of them (Milner, 1962). Apparently, he learned the new skill without consciously remembering doing it. In another experiment, patients with a severe memory disorder were able to recognize incomplete drawings faster after seeing them repeatedly, without consciously remembering them and stating they had never seen the drawings before (Milner, Squire, & Kandel, 1998), which is an example of the priming phenomenon.

These and many other studies suggest that there are different memory systems for *knowing how* (motor skills, automatic responses and associations) and *knowing that* (knowledge of facts and events; Squire, 1992; Squire & Wixted, 2011). 'Knowing how' can occur without the creation of a conscious memory of the learning process itself; learning is *implicit* or unconscious. For 'knowing that', the memory is consciously formed; the learning experience is *explicit*. For example, learning a foreign language or learning history at school requires effort and is a conscious exercise. On the other hand, many actions and procedures seem to be learned effortlessly or 'learned while doing'. These are actions that are based on routine, skills that one has learned in the past, such as cycling, driving a car, using an ATM or a coffee machine. These are examples of *implicit* or unconscious learning.

Dementia

Memory capacity and learning ability decline when we get older. This is caused by changes in brain function that accompany ageing: we slow down, experience memory problems and become less flexible. However, dementia is different from 'normal aging', as it is the consequence of a brain disease. Dementia is characterized by deficits in multiple cognitive functions, such as anterograde and retrograde amnesia, problems in spatial or temporal orientation, visual perception and object recognition, apraxia, in executive functioning (i.e., causing difficulties in reasoning, abstract thinking, planning and problem solving) or aphasia (difficulties in producing and understanding language). Also, persons with dementia may suffer from behavioural changes, such as disorganised and disinhibited behaviour (e.g., patients may laugh or cry at inappropriate moments, wander off, search aimlessly, become suspicious or demonstrate a lack of insight into their disease), or become apathetic.

Dementia can be caused by several brain diseases, each having its own cognitive consequences. In DSM-5 the concept of dementia is included in the diagnostic category Major Neurocognitive Disorder (MND), characterised by impairments in two or more (cognitive) functions (memory, executive functioning, attention, speech, language or behaviour). These impairments interfere with Activities in Daily Living (ADL) and cannot be explained by a delirium or depression (American Psychiatric Association, 2013).

Alzheimer's disease

In 2015, around 46.8 million people worldwide were diagnosed with dementia, a number that may almost double in the next 20 years (Prince, Wino, Guerchet, Ali, Wu, & Prina, 2015). Alzheimer's disease (AD) is the most common cause of dementia. In AD, there is progressive damage to brain cells (atrophy) in the brain. The cause of AD is not clear yet. The most prominent hypothesis is the amyloid-cascade hypothesis (Hardy & Selkoe, 2002), which states that there is a misbalance in the production and discharge of the amyloid beta protein, causing protein accumulation in the brain and preventing the neurons from functioning properly. In a later stadium tangles of the tau protein are also formed causing cell death. However, in many older persons amyloid is present without dementia, and many older persons become demented without amyloid burden (suspected non-Alzheimer pathology or SNAP), which underlines that the amyloid hypothesis lacks accuracy to tell the whole story (Mormino et al., 2016). The criteria for AD are outlined in disease-specific dementia criteria such National Institute of Neurological and Communicative Diseases and Stroke-Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA; McKhann et al., 2011).

The most prominent cognitive characteristic of AD is anterograde amnesia which is due to loss of brain cells in the medial temporal lobe (MTL) early in the course of the disease. The MTL (including the hippocampus) is essential for storing new information and creating new memories. Besides damage to the hippocampus, the disease progressively affects other brain areas, which leads to the loss of other cognitive functions, such as abstract thinking, attention, language, planning and praxis. During the progression of the disease, patients with AD become less aware of their own functioning. Due to the progressive nature of the disease daily functioning deteriorates and the individual with dementia will eventually lose his/her independence.

At present, no effective pharmacological treatment for AD exists, although acetyl-cholinesterase inhibitors may temporarily slow down the progression of the disease (Seltzer et al., 2004; Zec & Burkett, 2008). Alternatively, support from (neuro)psychologists, speech therapists, occupational therapists, physiotherapists and other health care professionals may help both patients and informal carers manage the day-to-day challenges of living with AD.

Vascular dementia and other dementias

Vascular dementia (VAD) is the second most common type of dementia (after AD) and is caused by cerebrovascular disease (Desmond et al., 2000). Examples of such pathology are one or more minor or major strokes (the blood supply to a part of the brain is suddenly cut off, permanent or temporary), causing the death of a small area of tissue in the brain, or small (blood) vessel disease that lies deep in the brain (known as white matter). The term vascular cognitive impairment (VCI) has been proposed as an umbrella term that includes the full spectrum of cognitive changes associated with vascular pathology (Gorelick et al., 2011). Causally related risk factors for VCI are hypertension, hypercholesterolemia, cardiac diseases and diabetes (Kloppenborg, van den Berg, Kappelle, & Biessels, 2008).

In general, deficits in speed of information processing and psychomotor speed characterise VAD. Where progression in AD is typically gradual but persistent, the course of VAD can be more staged. Memory disorders are also present in VAD, but these differ from those in AD. That is, memory deficits in VAD are characterised by encoding deficits, also related to the deficits in speed of information processing, and retrieval deficits, while the storage in itself is typically unaffected. The criteria for VAD are described in the DSM-5 (American Psychiatric Association, 2013; Sachdev et al., 2014).

In some patients, the dementia may be caused by both Alzheimer pathology and cerebrovascular disease, resulting in Mixed Dementia (MD; Holmes, Cairns, Lantos, & Mann, 1999). Other forms of dementia are Frontotemporal dementia (FTD), Huntington's disease, Parkinson's Disease (PD) and related disorders such as dementia with Lewy bodies (DLB), corticobasal degeneration (CBD) and multi-system atrophy (MSA).

Learning ability in dementia

People with AD and VAD show progressive deficits in explicit, or conscious, episodic memory functions. Questions about what they did yesterday, to whom they talked, or how they approached a task are difficult for them to answer. In turn, implicit, or automatic, procedural memory systems are relatively spared (Eichenbaum, Cohen, Otto & Wilbe, 1992). Therefore, people with (early-stage) dementia are often capable of performing procedural tasks such as preparing food, making tea, laying the table or dressing, sometimes with a little help or guidance. With a small cue, such as the first step of an activity, a person with dementia may be able to independently complete the activity, as one step automatically triggers the next in routine activities and overlearned skills. Given the opening lines of a known song, persons with dementia are able to sing along with the entire song, and within a church context, they may be able to retrieve prayers, because the sounds and context automatically trigger associations. Person with early-stage dementia have also been shown to be able to learn new skills and associations: someone who has moved to a new home can learn the way to the bathroom and which cupboard the cups are in. Given that implicit memory processes remain relatively unimpaired with progression of dementia raises the question of whether this may represent a way to promote learning.

More about implicit memory and implicit learning in dementia

As can be seen in Squire's memory taxonomy (2004), implicit memory encompasses more than motor skills and acquiring and performing activities such as cycling, making coffee or knowing the way (knowing *how* instead of knowing *what*). For example, associative learning, specifically conditioning, is a form of implicit learning, in which associations are formed between two or more stimuli under specific conditions, resulting in a fixed behavioural pattern. Many examples of associations can be found in daily life, such as smells that cue the retrieval of specific memories, specific foods that are avoided because they made a person sick long ago, feelings of appetite while looking at pictures of meals in a magazine, a child asking questions over and over because the child noticed it resulted in attention or candy in the past, or a person experiencing spider phobia because his/her mother also reacted fearfully to spiders. It is important to realise that people with dementia can learn new associations and thus behavioural patterns, even if they cannot consciously recall the circumstances that triggered the behaviour from explicit, episodic memory (Eichenbaum et al., 1992).

Emotions also play an important role in memory formation. Emotions enhances the learning experience and are imprinted along with memory content, referred to as emotional enhancement. For example, many people still remember exactly where they were during the events of September 11, 2001 in New York, but when asked where they were on a random other date that year, they may not be able to recall this. Emotional enhancement may be relatively preserved in patients with AD, especially during the early stages of the disease (Broster, Blonder, & Jiang, 2012; Mori et al., 1999). Both pleasant and unpleasant impressions may be consolidated and retrieved automatically under certain circumstances, without the person explicitly recalling these events (Feinstein, Duff, & Tranel, 2010; Guzman-Velez, Feinstein, & Tranel, 2014). For example, a person can have a positive feeling about the previous afternoon, without consciously remembering that this positive feeling was triggered by a grandchild's visit. People with dementia may also benefit from emotional memory enhancement during learning processes (Broster et al., 2012; Nashiro & Mather, 2011).

Feelings of helplessness, insecurity and failure due to memory loss may lead to anxiety, depression and behavioural problems. A positive approach towards people with dementia may enhance memory formation and reduce or even prevent behavioural problems. A pleasant learning experience, in which success and safety are experienced, in contrast to failure and frustration, may facilitate memory formation. When the person is exposed to the context or situation again, the positively associated emotion may be re-experienced.

Compensating for (explicit) memory loss by triggering and enhancing implicit learning might be a way for persons with dementia to relearn what is forgotten. Obviously, learning new tasks or skills is limited and becomes increasingly difficult as the dementia progresses. However, people with dementia are capable of learning new or relearning 'forgotten' knowledge or skills. The process of learning differs, however, from that in people without explicit memory deficits. An approach to improve functioning should be specially tailored to individuals with dementia. One approach is to optimize guiding and instructing people with dementia throughout the learning process.

Errorless learning

A specific teaching method that may work through implicit learning is Errorless Learning (EL). This approach is based on the notion that memory performance improves when errors are prevented during the acquisition and retrieval of information that is learned. A learning environment is created in which the occurrence of errors is minimised and the tendency to guess the correct answer or action is reduced as much as possible. EL is an instructional feed-forward method and the opposite of 'Trial and Error' Learning (TEL), in which the person attempts the activity and is given feedback or correction afterwards (Clare & Jones, 2008).

The principle of EL was first introduced by Terrace (1963). His behaviourist experiment involved the training of pigeons that were taught to discriminate between a red and a green key, using an EL approach and an error full approach (EF). Learning in the EL condition resulted in better colour discrimination performance compared to TEL. However, not until 30 years later did Baddeley (1992) discuss EL as potentially relevant for teaching amnesic patients (new) information. He suggested a role for the (relatively) spared implicit memory function in the consolidation of erroneous responses in these patients, resulting in poor memory performance. Healthy people who have intact explicit memory will recognize errors as such and correct them. However, amnesic persons such as individuals with dementia are less capable of distinguishing between 'correct' and 'incorrect' information, and incorrect responses can be erroneously and implicitly stored into LTM as a result. By preventing errors during learning, only the correct information will be consolidated in memory.

EL has been studied in patients with memory deficits due to a range of brain disorders including traumatic brain injury, stroke, Korsakoff's syndrome, schizophrenia and in elderly patients with mild, moderate or severe memory disorders, including dementia (Clare & Jones, 2008; Evans et al., 2000; Kessels & de Haan, 2003; Kessels, Feijen, & Postma, 2005; Kessels & Hensken, 2009; Komatsu, Mimura, Kato, Wakamatsu, & Kashima, 2000; Middleton & Schwartz, 2012; Mount et al., 2007; Mulholland, O'Donoghue, Meenagh, & Rushe, 2008; Ruis & Kessels, 2005; Wilson, Baddeley, Evans, & Shiel, 1994). Most of the studies that examined EL in people with dementia used laboratory tasks, with positive effects being reported for controlled experimental manipulations in various patient samples. However, it remains unclear how well these results would convey to a more natural situation (i.e., clinical practice or home situations) with tasks that bear true relevance to patients. Moreover, most studies did not investigate the long-term effects of EL in people with dementia. Furthermore, no practical manual, protocol, or guidelines on EL, offering an integrated, structured, and clinical approach, are available. Also, it is unclear whether and how health-care professionals need and incorporate structured teaching principles in their daily routines. Finally, no large clinical trials on the effects and feasibility of EL have been performed in persons with dementia.

Thesis outline

The aims of this thesis are threefold. First, the development and feasibility of a standardized EL manual for teaching everyday-life tasks to people with dementia is examined. Secondly, a new assessment method to rate task performance is evaluated. Thirdly, the effectiveness of an EL intervention is examined in a Randomized Controlled Trial (RCT), the REDALI-DEM study. This is a multi-centre RCT with the aim to evaluate the effects of EL vs. TEL on the performance of everyday-life tasks in people with mild to moderate dementia living at home.

Chapter 2 reviews the literature on the effectiveness of EL in teaching people with dementia everyday-life tasks. Moreover, the role of variables such as nature and severity of dementia, type of task, training intensity, EL elements, outcome measures, experimental designs and follow-up assessment is discussed.

In **Chapter 3** a survey is presented exploring the interest in and feasibility of EL in dementia care in the Netherlands. Based on the survey results and the results of the literature review in chapter 2 an EL manual was written and evaluated for use in clinical practice.

Chapter 4 examines the validity and reliability of a new assessment procedure. The Core Elements Method (CEM) is investigated, which rates essential building blocks of activities rather than individual task steps. In previous studies EL was mostly examined by counting the amount of correctly executed task steps or by rating them using a Task Performance Scale (TPS). Task performance was assessed in patients with Alzheimer's dementia using TPS and CEM independently and their interrater reliability was analysed.

In **Chapter 5** the treatment adherence of therapists participating in the REDALI-DEM pilot study is examined, using an EL versus a TEL protocol. Treatment adherence of the therapists in both learning conditions was monitored using video observations of two treatment sessions and were rated on three items (therapeutic interaction, dealing with errors, and manual adherence) by two raters on a six-point scale.

Chapter 6 is devoted to the main results of the REDALI-DEM RCT study in which EL is compared to TEL in teaching patients with dementia two everyday-life tasks at their homes.

Chapter 7 provides a summary of the main findings of this thesis and discusses the clinical implications of these results. Furthermore, strengths and limitations are discussed and suggestions for future research are made.

2 A review towards a clinical manual for (re)learning meaningful activities of daily living

Published as:

de Werd, M. M. E., Boelen, D. H. E., Olde Rikkert, M. G. M., & Kessels, R. P. C. (2013). Errorless learning of everyday tasks in people with dementia. *Clinical Interventions in Aging, 8*, 1177-1190.

Abstract

Errorless learning (EL) is a principle used to teach new information or skills to people with cognitive impairment. In people with dementia, EL principles have mostly been studied in laboratory tasks that have little practical relevance for the participants concerned, yet show positive effects. This is the first paper to exclusively review the literature concerning the effects of EL on the performance of useful everyday tasks in people with dementia. The role of factors such as type of dementia, type of task, training intensity, EL elements, outcome measures, quality of experimental design, and follow-up are discussed. The results indicate that, compared with errorful learning (EF) or no treatment, EL is more effective in teaching adults with dementia a variety of meaningful daily tasks or skills, with gains being generally maintained at follow-up. The effectiveness of EL is highly relevant for clinical practice because it shows that individuals with dementia are still able to acquire meaningful skills and engage in worthwhile activities, which may potentially increase their autonomy and independence, and ultimately their quality of life, as well as reduce caregiver burden and professional dependency. Suggestions for future research are given, along with recommendations for effective EL-based training programs, with the aim of developing a clinical manual for professionals working in dementia care.

Introduction

In dementia, most notably dementia due to Alzheimer's disease, memory impairments are among the most prominent cognitive deficits. These impairments predominantly affect episodic memory, with detrimental effects on the daily life functioning for those suffering from the condition, inevitably severely compromising their autonomy and quality of life. If people with dementia can (re)learn relevant activities and skills, this may improve their sense of competence and foster their ability to (partly) maintain their independence, as well as reduce the burden on professional and nonprofessional caregivers.

Non-pharmacological interventions, such as cognitive rehabilitation programs, that aim to facilitate performance and optimize the (re)learning of skills rather than restore the impaired function, have been found to be effective (De Vreese, Neri, Fioravanti, Belloi, & Zanetti, 2001; Viola et al., 2011). Typically, in patients with dementia such therapies focus on maintaining quality of life, despite the presence of deficits that may even progress over time (Clare & Jones, 2008; Kurz et al., 2012; Viola et al., 2011). Existing cognitive rehabilitation programs rely on structured feedback and repetition, as well as on the use of cognitive strategies and external aids, such as calendars or notebooks, to help optimize functioning. In their meta-analysis, Sitzer, Twamley & Jeste (2006) concluded that, in general, cognitive rehabilitation may be effective for improving learning, memory, executive functioning, and the performance of activities of daily living, general cognitive problems, and ameliorating depression in people with Alzheimer's disease. Errorless learning (EL) is one such cognitive rehabilitation strategy that has been gaining interest over the last two decades in the field of dementia care (Clare & Jones, 2008).

In rehabilitation, the principle of EL is used as an instructional method for individuals with compromised memory and executive functions and may involve any intervention aimed at reducing the number of errors throughout the various stages of learning. This error reduction may be achieved by any combination of graded tasks where the task at hand is broken down into small steps, immediate error correction, encouraging participants not to guess, modeling the task steps, fading cues and prompts when steps are successfully performed (vanishing cues), or rehearsal of the retrieval of information that is taught with increasing time intervals (spaced retrieval; Clare & Jones, 2008). Terrace first introduced EL in the early 1960s in an animal study (Terrace, 1963). His experiment involved the training of pigeons to discriminate between a red and a green key using both an EL and an errorful approach (EF), with learning in the EL condition resulting in superior memory performance. Because this implies that the reduction of errors facilitates the learning of behaviour or skills, Baddeley (1992) put EL forward as a potential learning aid to teach amnesic (new) information 30 years later, suggesting that EL addresses the (relatively) spared implicit memory functions in people with amnesia (Baddeley & Wilson, 1994; Clare & Jones, 2008). The rationale behind EL is that explicit memory is responsible for recognizing and correcting the errors that are made during learning. In people with deficits in explicit memory, such as individuals with Alzheimer's dementia (AD), these errors may not be recognized as such and are therefore not corrected but instead implicitly consolidated into long-term memory. To investigate this hypothesis, Baddeley and Wilson (1994) compared EF and EL using a word stem task in adults with memory impairments of mixed aetiology (including dementia). Their amnesic participants showed significantly better learning and less forgetting in the EL condition.

Since then, EL has been used in interventions aimed at memory and executive deficits resulting from, among other causes, traumatic brain injury, Korsakoff's syndrome, stroke or schizophrenia (Clare & Jones, 2008; Evans et al., 2000; Kessels & de Haan, 2003; Komatsu et al., 2000; Middleton & Schwartz, 2012; Mount et al., 2007; Mulholland et al., 2008; Wilson et al., 1994), as well as in elderly populations with mild, moderate, and severe memory disorders (ie, dementia; Clare & Jones, 2008). Grandmaison and Simard (2003) reviewed various memory stimulation and remediation programs for persons with AD and found the interventions that incorporated EL to be effective.

Most of the EL efficacy studies that have been reviewed so far used laboratory tasks, with positive effects being reported for controlled experimental manipulations in various patient samples. However, it remains unclear how well these results would convey to a more natural situation (ie, clinical practice or the home) with tasks that bear true relevance to patients. Moreover, most studies did not investigate the long-term effects of EL in people with dementia.

The objective of this review therefore is to evaluate critically the effectiveness of EL in teaching people with dementia meaningful activities of daily living. These refer to all activities, tasks, or skills that have some relevance in everyday life of the individual patient that may enhance his or her autonomy. One should think of (re)learning the names of familiar people, (re)training leisure activities, and (re)gaining communication skills (eg, preparing to go out for a walk, learning to use an MP3 player, or writing an e-mail). Also, we will examine the longevity of the effects reported (ie, the follow-up results) and provide recommendations about the practical feasibility and application of EL in clinical practice.

Methods

Potentially relevant studies were identified by searching PubMed, PsychInfo and Web of Science databases until April 12, 2013, using combinations of the search terms: "errorless learning", "Alzheimer", "dementia", "everyday activities", "daily life activities", "everyday memory problems", "everyday life functioning", "skill learning", and "everyday skills learning". In addition, reference lists from the retrieved articles were screened to identify additional papers. The PsycBITE internet site was also consulted. Articles were included for review if they met the following criteria:

1. The study sample(s) comprise(s) people with a diagnosis of dementia: Participants in the intervention studies have cognitive impairments resulting from neurodegenerative diseases, ie, a diagnosis of AD, semantic dementia (SD) or vascular dementia (VAD). Participants fulfill either the criteria for dementia as outlined in the Diagnostic and Statistical Manual of Mental Disorder (DSM-IV-TR; American Psychiatric Association, 2000), or disease-specific criteria such as those for Alzheimer's dementia as formulated by the National Institute of Neurological and Communicative Diseases and the Stroke-Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA; McKhann et al., 2011), the criteria for vascular dementia adhered to by the National Institute of Neurological Disorders and Stroke-Association Internationale pour la Recherche et l'Enseignement en Neurosciences (NINDS-AIREN; Roman et al., 1993), or criteria for semantic dementia or frontotemporal dementia (Gorno-Tempini et al., 2011; Neary et al., 1998; Rascovsky et al., 2011). In addition, studies were included if diagnoses were based on historic information, neurologic examination, neuropsychologic assessment, and supported by findings on structural and functional imaging.
2. Tasks are relevant to daily life and meaningful to the participants. Intervention studies evaluate the effects of EL in tasks that are potentially useful for the individuals with dementia to (re)learn, contributing to the preservation or enhancing their autonomy.
3. Error-reduction principles are applied. The intervention studies address the (re)learning of meaningful activities of daily living by means of EL. The actual application of EL principles shows a large variation in the literature and may include a combination of teaching principles, provided that the amount of errors made during the acquisition and/or retrieval phases of learning is kept to a minimum, or is prevented altogether. In table 2.1, various error-reducing methods are presented.
4. Outcome measures are quantitative and pertain to functioning in daily life. The methodology comprises at least one quantitative outcome measure, eg, the number of correctly performed steps and/or the number of errors made during task performance.
5. The intervention studies are controlled studies. Studies eligible for review are either group studies with a control group or control condition, comparing EL with another type of learning (ie, EF) or no treatment, or single-case studies (eg, multiple-baseline design, reversal design, or case series).

Table 2.1 Error-reducing methods applied in the studies reviewed

Method	**Definition**
No guessing	The participant is encouraged not to guess to prevent errors. Either the correct response is immediately offered, after which the participant is asked to repeat it, or the correct response is provided in case of hesitation or uncertainty.
Stepwise approach	The task is mastered step by step.
Modeling	The therapist demonstrates to the participant how each step is to be performed. The participant is first invited to repeat and master each step, before he/she is asked to execute the whole task unprompted, independently, and without errors.
Verbal instruction	The participant is explicitly explained what to do in each of the task steps or what is to be repeated.
Visual instruction	The therapist may give the participant any visual cue or prompt to help guide the participant through the task, such as a checklist with pictograms, a written action plan, or coloured stickers to indicate a specific object or place.
Vanishing cues	Targets are presented and cues gradually withheld after successful recall trials until the participant is able to give the correct response in the absence of cues.
Spaced retrieval	The participant is asked to recall (new) information after increasing delays. The therapist provides the correct response when the participant hesitates or indicates to not know the correct response. The recall interval is then reduced until the participant is able to reproduce the desired response, after which the interval is increased again until the participant is able to give the correct response after the longest interval.

To examine the effectiveness of EL, the following study aspects were scrutinized:

- Type of dementia and severity, based on Mini-Mental State Examination scores (MMSE; Folstein, Folstein, & McHugh, 1975), subdivided into four categories: minimal (MMSE; >23), mild (MMSE; 18-23), moderate (MMSE; 10-17), and severe (MMSE; <10; Greene, Hodges, & Baddeley, 1995; Hodges & Patterson, 1995).
- Task type, for instance, orientation tasks, familiar face-name associations, operating an electronic device or household appliance, and task novelty, ie, relearning previously known skills or acquiring new ones.
- Training intensity in terms of duration and frequency of training sessions.
- Training location, for instance, at home, in the hospital, or in a residential or nursing home.
- (Combinations of) EL elements applied in the intervention(s) evaluated.
- Experimental design.
- Outcome measures.

- Effectiveness.
- Maintenance of treatment gains at follow-up (i.e., after training had stopped) and (number and nature of) refresher sessions, if provided.

Because samples were small (*N*<12) in 24 of the 26 studies reviewed and because the learning procedures varied considerably among studies, we performed a qualitative analysis of the evidence rather than a formal meta-analysis.

Results

A total of 26 studies reported in 16 research articles were included, each employing some form of EL in teaching patients with dementia activities that they found relevant and meaningful for their daily lives, using error-reduction principles, quantitative outcome measures, and controlled study designs. As one of these studies (Clare, Wilson, Carter, Hodges, & Adams, 2001) described the follow-up assessment of a previous study by Clare et al. (1999), the results of that follow-up study are only described under the heading "Effectiveness and maintenance of treatment gains" and not in the remaining part of the Results section. Results for each of the studies are presented in Table 2.2.

Dementia type and severity

In total, 70 (older) adults with dementia participated in the various intervention studies. Most of the participants had AD (21 studies; Bier et al., 2008; Clare et al., 1999; Clare et al., 2000; Clare, Wilson, Carter, & Hodges, 2003; Clare, Wilson, Carter, Roth, & Hodges, 2002; Dechamps et al., 2011; Lekeu, Wojtasik, Van der Linden, & Salmon, 2002; Metzler-Baddeley & Snowden, 2005; Noonan, Pryer, Jones, Burns, & Lambon Ralph, 2012; Provencher, Bier, Audet, & Gagnon, 2008; Thivierge, Simard, Jean, & Grandmaison, 2008; Yamaguchi, Foloppe, Richard, Richard, & Allain, 2012) and severity varied between minimal, mild, and moderate. In three studies participants had minimal to mild SD (Jokel & Anderson, 2012; Robinson, Druks, Hodges, & Garrard, 2009). In one study the aetiology of the cognitive deficits was unknown for most patients due to the lack of biomarkers (with a high likelihood that the dementia in most of the participants resulted from AD; van Tilborg, Kessels, & Hulstijn, 2011).

Task type and novelty

Most studies focused on teaching participants the use of devices such as a mobile phone, answering machine, coffee maker, or microwave (Bier et al., 2008; Clare et al., 2000; Dechamps et al., 2011; Lekeu et al., 2002; Thivierge et al., 2008; van Tilborg et al., 2011). Participants also practiced face-name associations of familiar people, such as family members or members of a social club (Clare et al., 1999; 2000; 2003; 2002), and orientation skills (Bier et al., 2008; Clare et al., 2000; Provencher et al., 2008), such as the use of a calendar and directions (routes). Relearning the names of everyday objects was practiced in six

Table 2.2 Studies reviewed that compared the effectiveness of errorless learning and errorful learning or no treatment in people with dementia

Study	*N*	MMSE	Dementia type and severity	Task type and novelty	Training intensity: Duration and frequency	Training location
Bier et al. 2008	1	26	Minimal AD	Use of calendar to reduce repetitive questioning about date and calls made to family New	1.5 hour Unclear	At home
Bier et al. 2008	1	26	Minimal AD	Operating the cassette desk Familiar	1.5 hour Twice a week for 5 months	At home
Bier et al. 2008	1	26	Minimal AD	Participating in a social activity Familiar	1.5 hour Twice a week for 5 months	At home
Clare et al. 1999	1	27	Minimal AD	Names of members of a social club Unknown	Unclear Twice a week (total 21) and training at club and three times daily at home	At home
Clare et al. 2000	1	21-26	Minimal to mild AD	Familiar face-name associations Familiar	Unclear Unclear	Unknown
Clare et al. 2000	1	21-26	Minimal to mild AD	Personal information Familiar	Unclear Unclear	Unknown
Clare et al. 2000	1	21-26	Minimal to mild AD	Use of calendar and memory board Unknown	Unclear Unclear	Unknown
Clare et al. 2000	1	21-26	Minimal to mild AD	Use of a memory aid Unknown	Unclear Unclear	Unknown
Clare et al. 2001	1	27	Minimal AD	Names of members of a social club n/a	n/a n/a	n/a

EL elements and additional learning methods	Experimental design	Outcome measures	Effectiveness	Maintenance of treatment gains
Spaced retrieval Verbal association Spontaneous training by verbal cueing	ABAB	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	1 month (+)
Stepwise approach Verbal instruction Modeling Vanishing cues	Multiple baseline across activities	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	1,3,6,9 weeks (+)
Spaced retrieval	BA	Number/ percentage of correct steps/responses at baseline and after intervention	(+) *	1,3,6 weeks (+) *
No guessing Spaced retrieval Vanishing cues Mnemonic strategy	Multiple baseline across items	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	1,3,6,9 months (+)
No guessing Spaced retrieval Mnemonic strategy Repeated presentation	Multiple baseline across items	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	1,3,6 months (+)
No guessing Spaced retrieval Instructional audiotape	Multiple baseline across items	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	1,3,6 months (+)
Verbal instructions	ABA	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	3,6 months (+)
Verbal instructions	ABA	Number/ percentage of correct steps/responses at baseline and after intervention	(-)	3,6 months (-)
n/a (is a follow-up)	Trained items compared to untrained items	Number/ percentage of correct steps/responses at baseline and after intervention	n/a	Trained items 1 and 2 years (+) Untrained items 1 year (+) 2 years (-)

2

Table 2.2 Continued

Study	*N*	MMSE	Dementia type and severity	Task type and novelty	Training intensity: Duration and frequency	Training location
Clare et al. 2002	12	19-29	Minimal to mild AD	Familiar face-name associations Familiar	Unclear 6 sessions, (total 8) and practice at home until the one- month follow-up	Unknown
Clare et al. 2003	1	24	Minimal AD	Names of members of a support group Unknown	Unclear Between sessions practicing each set of names once daily at home for 3 months	Unknown
Dechamps et al. 2011	14	10-26	Minimal to moderate AD	IADL task Familiar	30 minutes 6 sessions within one week	At home
Jokel & Anderson 2012	7	23-29	Minimal to mild SD	Names of objects Familiar	Each set: 2.5 hour Each set: 2 or 3 times a week (total 12)	Unknown

EL elements and additional learning methods	Experimental design	Outcome measures	Effectiveness	Maintenance of treatment gains
Condition 1 No guessing Spaced retrieval Vanishing cues Mnemonic strategy Condition 2 No training	Pretest/ post-test design	Number/ percentage of correct steps/responses at baseline and after intervention	Condition 1 (+) Condition 2 (-)	Condition 1 1,3,6 months (+) 12 months (-) Condition 2 1,3,6, 12 months (-)
Condition 1 No guessing Spaced retrieval Mnemonic strategy Condition 2 No guessing Mnemonic strategy Repeated presentation	Multiple baseline across items	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	3, 6 months (+)
Condition 1 Stepwise approach Verbal instruction Visual instruction Condition 2 Stepwise approach Modeling Condition 3 Stepwise approach Trial and Error	Within-subject	Number/ percentage of correct steps/responses at baseline and after intervention	Condition 1 (++) Condition 2 (++) Condition 3 (+)	1 week Condition 1 (++) Condition 2 (++) Condition 3 (+) 3 weeks Condition 1 (++) Condition 2 (++) Condition 3 (-)
EL-Passive Verbal instruction EL-Active No guessing Verbal cues EF-Passive Guessing allowed Verbal cues EF-Active Guessing allowed Asking open ended questions	Within-subject	Number/ percentage of correct steps/responses at baseline and after intervention	EL condition (++) EF condition (+)	1 month EL condition (++) EF condition (+) 3 months EL condition (+) EF condition (+)

Table 2.2 Continued

Study	*N*	MMSE	Dementia type and severity	Task type and novelty	Training intensity: Duration and frequency	Training location
Lekeu et al. 2002	2	21 and 22	Mild AD	Use of a mobile telephone Unknown	45 minutes 1 or 2 times a week (total 13/14)	Unknown
Metzler-Baddeley & Snowden 2005	2	11 and 26	Minimal and moderate AD	Names of objects Familiar	Unclear Each set 3 times daily for 8 days (total 24)	At home and in the hospital
Noonan et al. 2012	8	9-24	Minimal to severe AD	Names of objects Familiar	40-60 minutes 2 times a week for 5 weeks (total 10)	Unknown
Provencher et al. 2008	1	24	Minimal AD	Route learning Unknown	30 minutes 14 weeks (total 17)	Unknown
Robinson et al. 2009	1	26	Minimal SD	Names, definition and the use of objects Familiar	Unclear 2 times a week for 3 weeks (total 6) and once daily using a DVD	Unknown
Robinson et al. 2009	1	22	Mild SD	Names, definition and the use of objects Familiar	Unclear 2 times a week for 2 weeks (total 4) and once daily using a DVD	Unknown

EL elements and additional learning methods	Experimental design	Outcome measures	Effectiveness	Maintenance of treatment gains
Stepwise approach Visual instruction Modeling Spaced retrieval	ABA	Number/ percentage of correct steps/responses at baseline and after intervention	(+)*	n/a
EL condition No guessing Mnemonic strategy EF condition Guessing allowed Mnemonic strategy	Within subject	Number/ percentage of correct steps/responses at baseline and after intervention	EL condition (+) EF condition (+)	n/a
EL condition Verbal instructions Visual instructions EF condition Cueing No treatment condition	Within subject	Number/ percentage of correct steps/responses at baseline and after intervention	1 week EL condition (++) EF condition (++) No treatment (+)	5 weeks EL condition (++) EF condition (++) No treatment (+)
Stepwise approach Modeling Vanishing cues Verbal cues	Multiple baseline across routes	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	10 weeks (+)
Condition 1 Modeling Verbal instruction Condition 2 No training	ABA	Number/ percentage of correct steps/responses at baseline and after intervention	3 days Condition 1 Object naming (+) Definition (+) Use (+) Condition 2 Object naming (-) Definition (-) Use (-)	1 month Condition 1 Object naming (+) Definition (+) Use (+) Condition 2 Object naming (-) Definition (-) Use (-)
Condition 1 Modeling Verbal instruction Condition 2 No training	ABA	Number/ percentage of correct steps/responses at baseline and after intervention	3 days Condition 1 Object naming (-) Definition (+) Use (+) Condition 2 Object naming (-) Definition (+) Use (-)	1 month Condition 1 Object naming (-) Definition (-) Use (-) Condition 2 Object naming (-) Definition (-) Use (-)

Table 2.2 Continued

Study	*N*	MMSE	Dementia type and severity	Task type and novelty	Training intensity: Duration and frequency	Training location
Thivierge et al. 2008	1	19	Mild AD	Using voice mail Familiar	45-60 minutes 2 times a week for 4 weeks (total 8)	Unknown
Thivierge et al. 2008	1	25	Minimal AD	Use of an answering machine Familiar	45-60 minutes 2 times a week for 4 weeks (total 8)	Unknown
van Tilborg et al. 2011	10 16	15-26 -	Minimal to moderate dementia Healthy elderly	Use of a microwave oven and a coffee maker New	15 minutes 5 sessions within one week	Unknown
Yamaguchi et al. 2012	2 2	22 and 23 -	Mild AD Healthy elderly	Virtually preparing two slices of bread and Virtually preparing a cup of coffee Familiar	20 minutes 1 session of 6 × 20 minutes	Unknown

Notes: *No p-values available
Abbreviations:. *N*, number of participants; IADL, instrumental activities of daily living; MMSE, Mini-Mental State Examination; AD, Alzheimer dementia; SD, Semantic dementia; EL, errorless learning; EF, errorful learning; n/a, not applicable; (+), significant effect; (++), significant effect versus baseline and other learning conditions; (-), non significant effect.

studies (Jokel & Anderson, 2012; Metzler-Baddeley & Snowden, 2005; Noonan et al., 2012; Robinson et al., 2009). Only six studies described in detail the grounds for selecting the particular activities, that is, after carefully interviewing the participant and his or her primary caregiver (Bier et al., 2008; Clare et al., 1999; 2003; Dechamps et al., 2011).

In the majority of studies, the participants relearned familiar but forgotten tasks or information (Bier et al., 2008; Clare et al., 2000; 2002; Dechamps et al., 2011; Jokel & Anderson, 2012; Metzler-Baddeley & Snowden, 2005; Noonan et al., 2012; Robinson et al., 2009; Thivierge et al., 2008; Yamaguchi et al., 2012). In two studies, novel tasks were learned (Bier et al., 2008; van Tilborg et al., 2011), while seven studies provided no information on this aspect (Clare et al., 1999; 2000; 2003; Lekeu et al., 2002; Provencher et al., 2008).

EL elements and additional learning methods	Experimental design	Outcome measures	Effectiveness	Maintenance of treatment gains
Stepwise approach Modeling Verbal instructions Spaced retrieval Vanishing cues	Multiple baseline across subjects	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	1 and 5 weeks (+)
Stepwise approach Modeling Verbal instructions Spaced retrieval Vanishing cues	Multiple baseline across subjects	Number/ percentage of correct steps/responses at baseline and after intervention	(+)	1 and 5 weeks (+)
<u>EL condition 1</u> Stepwise approach Verbal instruction <u>EL condition 2</u> Stepwise approach Modeling	Counter-balanced self-controlled cases	Number/ percentage of correct steps/responses at baseline and after intervention	EL condition 1 (+) EL condition 2 (+)	<u>7-10 days</u> EL condition 1(+) EL condition 2 (-)
<u>EL condition 1</u> Stepwise approach Verbal instructions Visual instruction <u>EL condition 2</u> Stepwise approach Visual instructions	Mixed factorial design between two single cases	Number/ percentage of correct steps/responses at baseline and after intervention	EL condition 1 (+)* EL condition 2 (+)*	n/a

Training intensity and training location

Overall, the intensity of training varied considerably between the studies reviewed (see Table 2.2). The number and/or duration of training sessions was not always specified in all studies (Bier et al., 2008; Clare et al., 1999; 2000; 2003; 2002; Metzler-Baddeley & Snowden, 2005; Robinson et al., 2009). Half of the studies gave complete and detailed information about their duration and frequency (Bier et al., 2008; Dechamps et al., 2011; Jokel & Anderson, 2012; Lekeu et al., 2002; Noonan et al., 2012; Provencher et al., 2008; Thivierge et al., 2008; van Tilborg et al., 2011; Yamaguchi et al., 2012), while five did not provide any information on either aspect (Clare et al., 2000; Clare et al., 2003). In six studies, the duration of training was unclear (Clare et al., 1999; Clare et al., 2002; Metzler-Baddeley & Snowden, 2005; Robinson et al., 2009). Training took place every week and in half of the studies at least twice a week (Bier et al., 2008; Clare et al., 1999; Jokel & Anderson, 2012; Lekeu et al., 2002; Metzler-Baddeley & Snowden, 2005; Noonan et al., 2012; Robinson et al., 2009; Thivierge et al., 2008), with sessions lasting between 30 minutes and 1.5 hours in most studies (Bier et al., 2008; Dechamps et al., 2011; Lekeu et al., 2002; Noonan et al., 2012; Provencher et al., 2008; Thivierge et al., 2008). However, the total number of sessions varied among the tasks trained (see Table 2.2). In nine studies, training comprised fewer than ten sessions (Clare et al., 2002; Dechamps et al., 2011; Robinson et al., 2009; Thivierge et al., 2008; van Tilborg et al., 2011; Yamaguchi et al., 2012), while in ten studies participants attended ten sessions or more (Bier et al., 2008; Clare et al., 1999; Jokel & Anderson, 2012; Lekeu et al., 2002; Metzler-Baddeley & Snowden, 2005; Noonan et al., 2012; Provencher et al., 2008). Moreover, four studies promoted additional practice in the home environment (Clare et al., 1999; 2000; 2003; 2002), one by involving the spouse as a co-therapist (Metzler-Baddeley & Snowden, 2005), and one using a DVD recording of the therapy sessions (Robinson et al., 2009). Most studies did not mention where the training took place (Clare et al., 2000; 2003; 2002; Jokel & Anderson, 2012; Lekeu et al., 2002; Noonan et al., 2012; Provencher et al., 2008; Robinson et al., 2009; Thivierge et al., 2008; van Tilborg et al., 2011; Yamaguchi et al., 2012). Five studies explicitly mentioned that the training was performed at home (Bier et al., 2008; Clare et al., 1999; Dechamps et al., 2011), and in two studies, the training took place both in the hospital and at home (Metzler-Baddeley & Snowden, 2005).

Errorless learning elements

EL can consist of a variety of instructions and task adaptations, which in the intervention studies reviewed were combined in various ways: participants were encouraged not to guess the correct response (Clare et al., 1999; 2000; 2003; 2002; Jokel & Anderson, 2012; Metzler-Baddeley & Snowden, 2005), a stepwise approach (Bier et al., 2008; Dechamps et al., 2011; Lekeu et al., 2002; Provencher et al., 2008; Thivierge et al., 2008; van Tilborg et al., 2011), the therapist modeled the task steps (Bier et al., 2008; Dechamps et al., 2011; Lekeu et al., 2002; Provencher et al., 2008; Robinson et al., 2009; Thivierge et al., 2008; van Tilborg et al., 2011), and finally, to guide task performance, the therapist provided verbal instructions (Bier et al., 2008; Clare et al., 2000; Dechamps et al., 2011; Jokel & Anderson, 2012; Noonan et al., 2012; Robinson et al., 2009; Thivierge et al., 2008; van Tilborg et al., 2011; Yamaguchi et al., 2012) and visual instructions (i.e., a written action plan or/and pictures of the actions; Dechamps et al., 2011; Lekeu et al., 2002; Noonan et al., 2012; Yamaguchi et al., 2012). In all studies, the EL elements were used during the acquisition phase or during the repetition of the task steps.

To facilitate the retrieval of task information and to rehearse action sequences, two other teaching techniques were frequently applied, ie, spaced retrieval and vanishing cues. Spaced retrieval was offered in 11 studies used in combination with visual instructions, a stepwise approach, verbal instruction and/or modeling (Bier et al., 2008; Clare et al., 1999;

2000; 2003; 2002; Lekeu et al., 2002; Thivierge et al., 2008). The vanishing cues method was applied in six studies (Bier et al., 2008; Clare et al., 1999; 2002; Provencher et al., 2008; Thivierge et al., 2008), with four using a combination of vanishing cues and spaced retrieval (Clare et al., 1999; 2002; Thivierge et al., 2008), and four (also) combining vanishing cues with modeling, verbal instruction, and a stepwise approach (Bier et al., 2008; Provencher et al., 2008; Thivierge et al., 2008). In all these studies, cues were gradually withheld in such a way that eventually participants were able to perform the tasks autonomously and unprompted.

Although EL aims to reduce errors during the acquisition and retrieval of information, errors may nevertheless occur during training. In these instances, the therapist should correct the error immediately. Thus, in the case of the vanishing cues method, renewed cues were provided by the therapist when errors occurred (Lekeu et al., 2002; Provencher et al., 2008; Thivierge et al., 2008). If errors occurred during spaced retrieval, the correct answer was offered, after which the former (shorter) interval was reinstated (Bier et al., 2008; Clare et al., 2003; Thivierge et al., 2008) or the interval was reduced by half (Clare et al., 1999; Clare et al., 2002; Lekeu et al., 2002). Fourteen studies did not specify whether or how errors were corrected (Bier et al., 2008; Clare et al., 2000; Dechamps et al., 2011; Jokel & Anderson, 2012; Metzler-Baddeley & Snowden, 2005; Noonan et al., 2012; van Tilborg et al., 2011; Yamaguchi et al., 2012) and in two studies no errors were made (Robinson et al., 2009).

Experimental design and outcome measures

As to experimental designs, we identified five group studies (Clare et al., 2002; Dechamps et al., 2011; Jokel & Anderson, 2012; Noonan et al., 2012; van Tilborg et al., 2011), with four comparing an EL approach with a no-treatment condition, or an EF condition in a counter-balanced within-subject design (Clare et al., 2002; Dechamps et al., 2011; Jokel & Anderson, 2012; Noonan et al., 2012). Noonan and colleagues (2012) applied a within-subject design to compare EL with EF and a no-treatment condition, analyzing the data at group and at participant level. In another study (van Tilborg et al., 2011), between-groups and within-group variances were computed in two conditions that will both be considered EL-type learning in this review. In 10 articles, 20 single-case studies were described. Eight of these had multiple-baseline designs across items or behaviours and across subjects (Bier et al., 2008; Clare et al., 1999; 2000; 2003; Provencher et al., 2008; Thivierge et al., 2008). Six studies applied an ABA design (Clare et al., 2000; Lekeu et al., 2002; Robinson et al., 2009), one study an ABAB reversal design (Bier et al., 2008), and one study a BA design (Bier et al., 2008). Two case studies examined the performance of two patients in both an EL and an EF condition, with the of order of learning conditions and the task trained in each condition being counterbalanced (Metzler-Baddeley & Snowden, 2005). Yamaguchi et al. (2012) employed a multiple-case study design including two healthy elderly patients and two patients with AD. A single-case study with a multiple-baseline design has a higher internal validity than a single-case study using a pre-to-post test design and thus provides more convincing evidence.

All studies used either the number or the percentage of correctly executed steps as their primary outcome measure or the number of correct responses given at the baseline and post-intervention assessments (Bier et al., 2008; Clare et al., 1999; 2000; 2003; 2001; 2002; Dechamps et al., 2011; Jokel & Anderson, 2012; Lekeu et al., 2002; Metzler-Baddeley & Snowden, 2005; Noonan et al., 2012; Provencher et al., 2008; Robinson et al., 2009; Thivierge et al., 2008; van Tilborg et al., 2011; Yamaguchi et al., 2012). Twelve studies (Bier et al., 2008; Clare et al., 1999; Dechamps et al., 2011; Jokel & Anderson, 2012; Lekeu et al., 2002; Provencher et al., 2008; Thivierge et al., 2008; van Tilborg et al., 2011) reported the number of correct steps executed or correct responses given during the intervention, while three studies scored every response according to the degree of assistance the participant required to perform the task independently (Dechamps et al., 2011; Thivierge et al., 2008).

Effectiveness and maintenance of treatment gains

Seventeen of the 25 studies demonstrated a statistically significant superior effect of EL immediately after training compared with EF or a no-treatment condition (Bier et al., 2008; Clare et al., 1999; 2000; 2003; 2002; Dechamps et al., 2011; Jokel & Anderson, 2012; Noonan et al., 2012; Provencher et al., 2008; Robinson et al., 2009; Thivierge et al., 2008; van Tilborg et al., 2011). One of these studies obtained a significant group-level effect, with not all participants showing an EL benefit (Clare et al., 2002). Robinson et al.(2009) found that only some aspects of the tasks trained culminated in statistically significant effects. In five other studies, performance levels had improved after EL, but no *p*-values were reported (Bier et al., 2008; Lekeu et al., 2002; Yamaguchi et al., 2012). Two studies found no differences between EL and EF (Metzler-Baddeley & Snowden, 2005), and Clare et al. (2000) found no beneficial effects of EL. Taken together, evidence of a statistically significant superior effect of EL was reported in five group studies, eight multiple-baseline studies, one study using an ABAB, and three studies using an ABA design.

To examine whether the EL effects were preserved over time, 20 of the 26 studies carried out follow-up evaluations, 17 of which showed maintenance of EL effects after one week up to nine months (see Table 2.2; Bier et al., 2008; Clare et al., 1999; Clare et al., 2000; Clare et al., 2003; Clare et al., 2001; Clare et al., 2002; Dechamps et al., 2011; Jokel & Anderson, 2012; Noonan et al., 2012; Provencher et al., 2008; Thivierge et al., 2008; van Tilborg et al., 2011). The time span between the post-intervention and the follow-up assessments varied considerably, ie, between one and three weeks in seven studies (Bier et al., 2008; Dechamps et al., 2011; Noonan et al., 2012; Thivierge et al., 2008; van Tilborg et al., 2011), and one month or more (with the longest follow-up interval lasting up to 2 years) in 18 studies (Bier et al., 2008; Clare et al., 1999; 2000; 2003; 2001; 2002; Jokel & Anderson, 2012; Noonan et al., 2012; Provencher et al., 2008; Robinson et al., 2009; Thivierge et al., 2008). Some studies conducted repeated follow-up assessments, eg, every three weeks (Bier et al., 2008;

Dechamps et al., 2011) or every three months (Clare et al., 1999; 2000; 2003; 2002; Jokel & Anderson, 2012).

In 13 of the studies reporting positive follow-up results, participants did not continue to practice the tasks between intervention cessation and follow-up (Bier et al., 2008; Clare et al., 2000; Clare et al., 2001; Dechamps et al., 2011; Jokel & Anderson, 2012; Noonan et al., 2012; Provencher et al., 2008; Thivierge et al., 2008; van Tilborg et al., 2011), although in two of these studies participants were exposed to the trained task every day (without actually re-training it; Bier et al., 2008; Provencher et al., 2008), with Provencher et al. (2008) recording a significant improvement in performance over time. Comparing EL and EF, another study showed an advantage for EL after one month, but not after three months, although the overall gains were maintained to a significant degree (Jokel & Anderson, 2012). Van Tilborg and et al. (2011) found a sustained EL effect for only one of the two tasks trained.

In four studies, participants attended one or more refresher sessions during the follow-up interval, resulting in positive effects (Clare et al., 1999; 2003; 2002; Thivierge et al., 2008). In these refresher sessions, the task was practiced again adhering to the EL procedure adopted during the intervention. Three of the four studies, however, failed to describe their number and duration in detail (Clare et al., 1999; 2003; 2002). One of the studies offering refresher sessions even reported treatment effects six months after training (Clare et al., 2002). After one year performance had declined, remaining, however, above baseline level. Regrettably, the study does not detail refresher training intensity.

Discussion

The results of our review of 26 studies applying principles of EL show that people with minimal to moderate dementias can (re)learn meaningful daily life skills or relevant knowledge using an error-reducing teaching approach. Five controlled group studies and 12 single-case studies obtained significantly superior effects using EL. Another five (preliminary) studies also reported benefits, but had not run statistical analyses on their data, rendering the conclusions as to EL effectiveness equivocal. Notably, a considerable number of the studies we reviewed included follow-up assessments, showing that effects were preserved over time, even weeks or months after the training had ended. Based on these findings, EL appears to be a promising principle to teaching (older) adults with compromised memory and executive functions due to neurodegenerative syndromes to (re)gain relevant daily life skills, fostering their confidence and self-reliance.

The results extend those reported in previous EL efficacy studies in which various patient populations learned to master different kinds of laboratory tasks, such as arbitrary face-name associations and word lists (Baddeley & Wilson, 1994; Haslam, Gilroy, Black, & Beesley, 2006; Hunkin, Squires, Parkin, & Tidy, 1998; Ruis & Kessels, 2005). Although, in their review, Grandmaison and Simard (2003) had earlier shown that cognitive rehabilitation programs for patients with dementia may benefit from error-reducing principles, the merit of the current review is that it demonstrates the beneficial effects of EL on meaningful, everyday tasks, thereby establishing its suitability and feasibility for implementation in clinical practice for dementia care. As also evident from our review, despite the progressive nature of dementias, the effects are long-lasting, being maintained at least one to three weeks.

The mounting evidence that individuals with dementia are still able to acquire new, or regain forgotten skills and knowledge, is important for professionals working in dementia care, since errorless principles in training meaningful skills may offer new opportunities for interventions aimed at people with dementia. When patients are encouraged to (re)learn meaningful daily activities in the early stages of their dementia, they may be enabled to step up their activity levels, fostering their sense of competence, potentially resulting in a higher degree of independence, and ultimately improving their quality of life (Cohen, Ylvisaker, Hamilton, Kemp, & Claiman, 2010). Moreover, it can help people with dementia to function, with assistance and support, longer in their home environment. Furthermore, as the underlying principle of EL is preventing errors, this implies success for the patient in every training session, which helps create positive memories during learning, furthering the consolidation and retrieval of information, and improving mood (Kensinger, 2004).

The effectiveness of EL has been investigated and confirmed in a multitude of tasks involving relevant daily life activities and skills, such as the use of electronic devices and household appliances, orientation skills, face-name associations, and the definitions and uses of objects. It has been suggested that EL is most successful in tasks that have an implicit procedural learning aspect to them (Evans et al., 2000). However, our review shows that EL is effective in both procedural and nonprocedural tasks. Further, EL benefits were found to be most pronounced in the early stage of the disease, when progression is relatively slow and impairments in other cognitive domains are still mild. Although the studies we reviewed did not explicitly include patients with Mild Cognitive Impairment (MCI), MMSE scores of the participants in the minimally severe groups show overlap with those typically found in individuals diagnosed with MCI (Petersen, 2004). Thus, EL may also be effective in teaching people with MCI relevant daily life skills, as some studies have already shown (Akhtar, Moulin, & Bowie, 2006; Jean, Simard, van Reekum, & Bergeron, 2007). This is consistent with studies that reporting large positive effects of EL in mild to moderate dementia (Kessels & Hensken, 2009; Zanetti et al., 2001), with smaller effects being reported in severe dementia (Ruis & Kessels, 2005). This is likely due to a decline in other non-memory cognitive (eg, executive) functions in addition to a further decline in the memory domain. Nevertheless, future studies should examine whether EL may still be applicable in older adults with more severe dementias residing in nursing homes, given that some studies have reported positive effects in this population using selected tasks that were adjusted to the participants' performance levels (Dechamps et al., 2011).

Our results additionally show that despite the differences in aetiology, EL is effective in both AD and SD. There are, of course, dementia-specific differences in memory dysfunction in that episodic memory is most impaired in AD, while semantic memory deficits are most prominent in SD. Thus, while patients with SD may have a better preserved episodic learning capacity, they may still benefit from EL. In the studies reviewed, the difference between the two dementia types predominantly lies in the type of task being practiced. The study participants with SD mostly (re)learned non-procedural tasks, whereas participants with AD trained both procedural and nonprocedural tasks.

Notwithstanding the success of EL in helping persons with dementia (re)engage in meaningful (daily) activities, the question remains as to how EL principles can best be applied in clinical practice. Some of our recommendations follow from the results of our review. Obviously, the essence of EL is creating a learning environment in which it becomes difficult or impossible for a person with dementia to make errors. Based on our findings, we pose that, depending on the activity or skill to be trained, a combination of several error-reduction principles is likely to be most effective. More specifically, modeling and verbal instruction, in combination with a stepwise approach, were shown to be beneficial in the acquisition of procedural tasks. The vanishing cues technique was used effectively to systematically decrease the degree of assistance during the acquisition phase of both procedural and nonprocedural tasks. Spaced retrieval was applied successfully in tasks requiring acquisition of nonprocedural information, as in face-name associations, where asking people not to guess was also found to be relevant. Verbal instruction was applied in both procedural and nonprocedural tasks as well, where the therapist verbally guides clients through the task steps to prevent errors.

Training intensity also plays an important role in the success of EL. However, studies varied considerably in this respect, with not all studies providing detailed information. Training sessions were mostly delivered once or twice a week. Durations of each training session ranged from 20 minutes to 2.5 hours, with the number needed for successful task completion varying between six and 21 sessions. This diversity prevents firm conclusions from being drawn about the minimal intensity that is required for EL to produce a clinically relevant effect. Of course, training intensity also depends on dementia severity and the tasks to be (re)learned, as well as individual differences, eg, motivational or psychosocial factors and physical limitations. Individual training programs should therefore be tailored to each individual patient and the task at hand. Training may be based on goals rather than on a fixed number of sessions; for example, the patient needs to be able to perform the targeted activity three times successfully on two consecutive training days. One could consider involving the spouse or caregivers to support additional training in the patient's home environment. Given that with EL training is often laborious and time-consuming, a therapeutic role of family members or carers can also contribute to the cost-effectiveness of the approach (Clare et al., 1999; 2003). Grandmaison and Simard (2003) concluded that a dyadic approach, in which caregivers help the patient apply various memory and cognitive improvement strategies, is one of the most promising approaches to the cognitive rehabilitation of patients with AD. While EL enables family members or caregivers to engage actively and constructively in joint activities with their spouse or client, there is the risk that such a therapeutic role for family members or carers may potentially increase their care burden instead of reducing it (Bruce, McQuiggan, Williams, Westervelt, & Tremont, 2008). Care should be taken that health professionals remain the principle care provider guiding the actual learning process, where the caregiver can then help the patient train or maintain the newly learned skills in their home environment.

Because the studies we reviewed reported positive effects that were obtained in both institutional and domestic settings, they do not prompt specific recommendations on the optimal training site. However, it is known from studies in rehabilitation settings that in order to facilitate generalization, training locations and materials should bear as close a resemblance to the patients' experience and daily life as possible (Geusgens, Winkens, van Heugten, Jolles, & van den Heuvel, 2007). To our knowledge, no research has been done to establish whether EL training at home yields better results than when training takes place elsewhere.

Recommendations for future research

Our search of the relevant literature produced a notable number of single-case studies, most with experimental designs ensuring good internal validity. Nevertheless, to reliably establish the effects of EL, study designs affording higher internal validity need to be applied in larger population samples. The five group studies included in our review all employed a control condition and randomization, but the number of participants was still relatively small (n=15). Clearly, randomized controlled trials (RCTs) with sufficiently large samples are required to replicate the current results. Also, such randomized controlled trials should not only study the efficacy of EL, but also its effectiveness (see eg, Voigt-Radloff et al.(2011)). Given that learning deficits may differ across dementia types due to the different underlying aetiologies and cognitive profiles, RCTs should include sufficiently large subsamples of different aetiologies, allowing evaluation of EL effectiveness and applicability in the different types of dementias. They should also consider dementia severity to uncover at which stage of the disease EL is most effective. Moreover, it is important to examine systematically whether different types of tasks (procedural vs. nonprocedural) benefit from different types or combinations of training principles, carefully specifying EL procedures and training intensity. Because these aspects were not always detailed in the papers we reviewed, we cannot make any recommendations in this respect. Evidently, future studies need to provide clear and detailed descriptions of the learning procedures employed, training intensity, duration and location(s), aetiology, disease severity and all other factors that may influence learning effects. Finally, the various studies compared the magnitude of correct responses at baseline, during and after the intervention, and at follow-up. None assessed changes beyond the ones measured on the tasks or skills trained. To monitor patients' overall level of (daily) functioning, observation rating scales from the field of occupational therapy could be used in addition to inventories gauging quality of life.

Conclusion

This review shows the effectiveness of EL in teaching people with different types of dementia meaningful activities of daily living. These learning gains are mostly maintained over a prolonged period of time, with or without refresher sessions. Positive effects are mostly studied and obtained in the early stages of dementia. Undeniably, people with dementia can still (re)acquire (some) useful skills and relevant daily life activities. Procedural tasks can best be trained using a stepwise approach, with the therapist modeling each step and providing verbal cues to guide the patient. Verbal instructions, spaced retrieval, and asking patients not to guess are most suitable for the acquisition of nonprocedural tasks. Vanishing cues are effective in steadily reducing the amount of help needed from the therapist and can be used in all task types. Training intensity and duration should be tailored to the needs of the individual patient and preferably take place in a familiar environment to facilitate acquisition.

EL helps build up activity levels, the motivation for undertaking new activities, and the sense of competence, which together may result in more autonomy, independence, and better quality of life for people with dementia. EL-based interventions provide health professionals with an opportunity to interact with their patients in a more positive way, focusing on residual abilities and learning capacities rather than deficits and decline. We hope that the insights gained from our review about the effectiveness and practical feasibility of EL can be used for developing a manual for clinical practice.

3 Development and evaluation of a clinical manual on errorless learning in people with dementia

Published as:

de Werd, M. M. E., Boelen, D. H. E., Olde Rikkert, M. G. M., & Kessels, R. P. C. (2015). Development and evaluation of a clinical manual on errorless learning in people with dementia. *Brain Impairment, 16*, 52-63.

Abstract

Various studies have shown the efficacy of errorless learning (EL) in teaching patients with dementia a wide variety of skills and everyday tasks, with some studies showing beneficial effects and other reporting limited or no advantage. However, EL procedures vary greatly and to date no clinical guidelines or manuals are available. Here, we present a nationwide survey exploring the interest in and feasibility of EL in dementia care in the Netherlands. Based on the survey results and available evidence in the literature we subsequently drafted an EL manual and had this concept manual evaluated in a Delphi round using the AGREE instrument.

Forty-five health professionals associated with 22 dementia care facilities in the Netherlands, including those survey respondents who had piloted an EL intervention in accordance with the concept manual and an eight-strong expert panel representing various disciplines deemed EL to be meaningful and feasible for use in dementia care and their residential facilities.

Although our manual was favourably received, future studies are required to examine how EL can best be implemented in clinical practice and to determine the optimal outcome measures and quality indicators to reliably evaluate intervention outcomes and to consider the cost-effectiveness of the approach.

Introduction

Currently, approximately 24 million individuals around the world have a dementia diagnosis, a number which is expected to double in the next 20 years (Qiu, De Ronchi, & Fratiglioni, 2007). With dementia already having a major impact on healthcare costs (Jonsson & Wimo, 2009; Wimo, Winblad, & Jonsson, 2010), in its 2010 World Alzheimer Report, Alzheimers Disease International (ADI) predicted a near-doubling in worldwide societal costs from US$604 billion in 2010 to US$1,117 billion by 2030 (Prince, Prina, & Guerchet, 2013). The financial burden mainly results from the professional care that is needed to compensate for the deterioration in the patients' performance of activities of daily living (ADL) due to the severe and progressive cognitive decline, eventually necessitating admission to nursing homes or other care facilities when patients are no longer able to function independently and informal caregiver burden becomes too high.

Pharmacological interventions have so far only shown relatively modest effects on cognitive and ADL capability in people with mild to moderate dementia (Seltzer et al., 2004; Zec & Burkett, 2008) . The challenge in dementia care therefore is to try and keep individuals with dementia as independent for as long as possible. Reducing informal caregiver burden and behavioural problems in people with dementia may help delay nursing home admission while augmenting both the patient's and the caregiver's quality of life and reducing societal costs. Typically, non-pharmacological dementia treatments such as cognitive rehabilitation (CR) programmes focus on maintaining quality of life despite the deficits that are likely to progress over time. CR interventions aim to increase the patients' autonomy and decrease caregiver burden by exploiting compensatory and restorative strategies and may comprise adaptations of the environment, the use of external aids, and interventions to relearn specific skills. Specific teaching methods have been developed that promote the use of strategies based on automatic, implicit forms of learning, which are relatively spared in dementia (Baddeley & Wilson, 1994). One such approach is errorless learning (EL). The basic assumption of EL is that errors made during the acquisition phase of learning may interfere with correct responses during the retrieval of what has been learned. Due to explicit memory deficits, these errors are not recognized and corrected, but may be implicitly consolidated in memory. Systematic reviews of the literature indicate that, compared to trial-and-error learning or errorful (EF) learning, EL is considered a promising method in some studies, but shows a limited or no advantage in other studies on brain impaired patients, including dementia (Clare & Jones, 2008; Middleton & Schwartz, 2012). Specifically focusing on everyday-skill learning in dementia, de Werd, Boelen, Olde Rikkert, and Kessels (2013b) report that EL has been found to be beneficial in some studies in people with dementia. Studies that have included long-term folllow-up assessment also report beneficial effects of EL (de Werd et al., 2013b). While studies show that at least some people with dementia are able to reacquire meaningful skills, potentially improving and prolonging their autonomy, independence, and quality of life while reducing both the informal caregiver and societal burden, findings so far are mixed. This may partly be due to methodological shortcomings and a large variety in EL instructions, trained tasks and treatment duration. Specific information on the effective ingredient of EL is needed in order to implement EL in dementia care.

One important issue that is relevant in this respect is that treatment success also depends on an individual's active effort during the acquisition of information. In more standard, passive approaches to EL the information to be learned is simply repeated and the answers are provided by the trainer. In addition, an EL approaches which promotes active and deep encoding by, for instance, directing the patient's focus of attention to the information to be learned and creating semantic cues to self-generate the correct responses (self-generation method). This approach has been shown to enhance the effects of EL (Lubinsky, Rich, & Anderson, 2009; Metzler-Baddeley & Snowden, 2005; Tailby & Haslam, 2003). Tailby and Haslam (2003) found an overall benefit of EL over EF learning in terms of the number of words recalled in people with acquired brain injury (including three dementia patients). In the self-generated EL condition, in which strong semantic cues were given, patients retained significantly more words than in the standard (passive) EL condition. These results were replicated by Laffan, Metzler-Baddeley, Walker, and Jones (2010) in a group of patients with Alzheimer's dementia, prompting their conclusion that cued recall (self-generated EL) yields significantly better outcomes than those obtained with standard EL. They also found that the Alzheimer patients with milder overall cognitive impairments benefited more from active generation than the more severely impaired patients. Middleton and Schwartz (2012) stated that passive EL might not be the preferred approach when the target skill requires the explicit recall of learned information. A more active way of learning appears more appropriate. The application of EL in clinical practice should preferably comprise a combination of teaching techniques aimed at reducing the amount of errors during acquisition as much as possible and effortful learning strategies involving a deep and 'meaningful' encoding of the information to be learned (de Werd et al., 2013b). Such EL interventions should then involve elements like inviting the patient not to guess, having the patient master the task in small, comprehensible steps with the steps being customized by the therapist, providing verbal instructions, and using vanishing cues (VC) to gradually decrease the need for assistance during recall. By actively guiding the patient while preventing errors from being made, the patient is coached to perform the task her/himself (self-generated EL).

However, to date no practical manual, protocol, or guidelines on EL are available that offer such an integrated, structured, and implementable approach, neither do we know whether and how health professionals use and incorporate structured teaching principles in their daily routines and whether there is a true need for EL in dementia care. With the present study we, therefore, first aimed to explore the interest in and feasibility of an EL teaching protocol by means of a nationwide survey among dementia professionals. We subsequently sought to translate the survey results and conclusions from the existing literature into a manual on EL for use in dementia care and, finally evaluated its content and clinical feasibility.

Methods

Feasibility survey

The survey to explore the need for and feasibility of an EL manual for use in dementia care was sent via e-mail to the 33 nursing homes and private dementia residences that were part of our Radboud Alzheimer Centre nursing-home network. Care was taken that different health disciplines (i.e., physicians, psychologists, occupational therapists, physiotherapists, speech therapists, activity coordinators, and geriatric nurse and nursing assistants) were recruited. The questionnaire contained items about the type of teaching methods respondents had been using to date (if any), which disciplines were involved in the teaching programmes, what kind of tasks, activities or skills were deemed useful and feasible for (re)learning, expectations of EL in terms of augmented learning outcomes, and which disciplines within the facilities could best promote learning abilities in residents with dementia (for the full feasibility survey, see Appendix A).

For analysis of the survey results we followed the methodology used by Joosten-Weyn Banningh, Vernooij-Dassen, Olde Rikkert, and Teunisse (2008) in their study, which was adapted from grounded theory (Corbin & Strauss, 1990). First, the answers to the open-ended questions were transcribed and categorized into different concepts by three independently operating teams (no consulting among teams) each consisting of two neuropsychologists with expertise in dementia. Each team defined domain concepts, that is, common denominators for various responses and response categories. Thus, washing and dressing were categorized as *Activities of Daily Living (ADL)*, while walking with a walking aid and chair-to-bed transfers were classified under *Mobility*. These preliminary concepts were subsequently discussed in a plenary meeting until consensus was reached among team members on the final concepts for analysis. These were additionally scrutinized by an independent assessor and definitive concepts (see Appendix A) were determined during a second plenary meeting. For each concept response frequencies were determined. For example, the question "*Which other tasks, skills or activities could individuals with dementia in your facility (re)learn*" yielded the following answers: *Washing, making coffee, dressing, using the telephone, using a GPS, using an alarm clock*. As *washing* and *dressing* are covered by the ADL concept, this was awarded a frequency score of 2, as were the IADL (instrumental activities of daily living) concept (*making coffee* and *using a telephone)* and the orientation skills concept *(using a GPS* and *using an alarm clock)*.

Development and evaluation of the EL manual

Trial in care facilities

With the aim to provide healthcare professionals with a comprehensive 'hands-on' description of how to apply EL in clinical practice, based on the results of the feasibility survey and literature reviews (Clare & Jones, 2008; de Werd et al., 2013b; Middleton & Schwartz, 2012) we composed a first draft of the EL manual. This manual described EL as a teaching method in which patients are prevented from making errors during the acquisition or retrieval of information and skills. With our concept manual we sought to provide guidelines, evidence-based working instructions, and practical suggestions for EL training schemes, together with clinical examples. Chapter 1 of the manual comprised the rationale and general description of EL as based on the literature. It further specified which type of patients might benefit (most) from EL and which care disciplines are considered most suitable to provide the interventions. It next provided suggestions for task selection, training intensity and duration; finally, trainer requirements and interdisciplinary communication and transfer were discussed. The next chapter contained the actual EL working instructions, consisting of a meticulous, step-by-step description of error-prevention techniques and suggestions on how to fade out support once the targeted information or skill has been retrieved. Also, additions to the basic EL procedure were proposed (e.g. offering ancillary visual cues or repetitions). Procedures were further illustrated with practical examples of tasks, prompts, and visual cues (see Figure 3.1) and comprehensive descriptions of adapted training sessions were provided.

Brushing teeth

1) Take a toothbrush and toothpaste
2) Put some toothpaste on the toothbrush
3) Put the toothpaste back in the cupboard
4) Brush your teeth
5) Rinse your mouth with water and spit it out
6) Wash the toothbrush with water and put it back in the cupboard

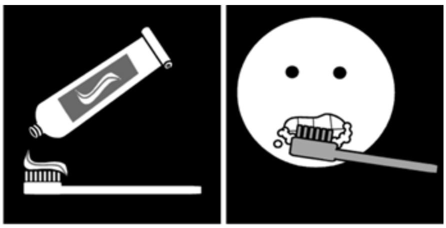

Figure 3.1 Example of a step-by-step EL action plan for 'brushing teeth'. Pictograms have been added to clarify some of the steps. These (and many other) pictograms may be freely downloaded from www.sclera.be

We next had this concept manual with its detailed EL working instructions evaluated in several steps. The draft was first sent to the care facilities that had participated in the feasibility survey with the request to have various members representing different disciplines scrutinize the manual and stage a pilot EL intervention with one of their residents diagnosed with dementia or patients suffering from other severe cognitive impairments due to stroke or traumatic brain injury (TBI). Worksheets were provided to evaluate the training sessions. One worksheet inquired about the applicability of EL as described in the concept manual and details of the training sessions delivered (e.g. duration, type of task trained).With the use of a visual rating scale (using emoticons with happy-to-sad faces) the participating residents were invited to rate their experience with the training session. We refer the reader to Appendix B and C for the complete worksheets and patient rating form.

Delphi round

In a subsequent Delphi round, all professionals who had piloted an EL training programme for a resident with dementia were asked to fill in the Appraisal of Guidelines for Research & Evaluation (AGREE) questionnaire (Poitras et al., 2007; The AGREE Collaboration, 2001). A validated instrument to assess manuals and protocols. It consists of 23 questions covering six domains querying 1) the scope and purpose, 2) stakeholder involvement, 3) rigour of development, 4) clarity of presentation, 5) applicability, and 6) editorial independence, and one final item asking for an overall appraisal of the manual and whether the respondent would recommend it for use in clinical practice. A supplement elucidates the domains and provides instructions on how to rate each item using a 4-point scale (1–fully disagree to 4–fully agree). AGREE domain scores are calculated by summing up the scores of the individual items of a domain and by scaling the total as a percentage of the maximum possible score for that domain. To facilitate the respondents in rating *rigour of development*, they were provided with relevant papers on EL in dementia, because in the concept manual the information on this topic was incomplete.

We also had the concept manual evaluated by an independent expert panel consisting of healthcare professionals from various disciplines with expert knowledge and experience in the field of dementia care (physicians, neuropsychologists, occupational therapists, physiotherapists, and speech therapists). The panel also completed the AGREE questionnaire and were asked to provide additional feedback and suggestions for improvement.

Results

The following sections summarize the results of the feasibility survey and the Delphi round. The survey's domain concepts are printed in italics and clarified where this was deemed opportune, with frequencies for the various concepts or percentages for the answers provided between brackets.

3

Feasibility survey results

Respondent characteristics

A total of 45 healthcare professionals associated with 22 care homes responded and the data they provided were all analysed. The demographics of the respondents are listed in Table 3.1. The greater majority (*N*=43) worked in a nursing home; the two other respondents were the owners of a private care residence for people with dementia and a dementia day-care centre. Of the 45 forms, 42.2% had been completed by *psychologists* and an equal proportion by professionals of other *care disciplines*, with *medical doctors* (6.7%) and *nursing staff* (8.9%) having completed the remaining seven forms. All respondents were experienced in working with people with cognitive impairments due to dementia, stroke or TBI.

Table 3.1 Characteristics of the feasibility survey respondents

Demographics	**Frequency**
Nursing homes	20
Private residences	2
Psychologist	19
Occupational therapist	9
Physiotherapist	5
Speech therapist	2
Activity coordinator	2
Dietician	1
Medical doctor	3
Geriatric nurse	4
<1 year clinical experience	3
1-5 years clinical experience	17
6-10 years clinical experience	9
11-15 years clinical experience	6
>15 years clinical experience	10

Applicability of EL in patients with dementia

All respondents deemed EL applicable in people with mild dementia; 63.6% indicated that EL might be most useful for people with moderate dementia, while 86.4% reported that EL would not benefit people with severe dementia. In addition, 75% of the respondents noted that EL might be beneficial for people with mild cognitive impairment (MCI). The majority judged EL to be relevant and applicable for various care facilities and disciplines: dementia day clinic (86.7%), dementia day-care centre (57.8%), rehabilitation unit (77.8%), special care units (80%), somatic unit (77.8%), but also at peoples' home (22.2%).

Current skill training and learning methods

Among the tasks and skills being trained most frequently in the respondents' facilities at the time of the survey were *IADLs* (32), *ADLs* (24), and exercises promoting the residents' *mobility* (25; e.g. bed-to-chair transfers, use of a walking aid), with skills in the *orientation* (11) and *leisure activities* (2) domains also being practised. Training was mainly provided by occupational therapists (70.5%), physiotherapists (59.1%), nursing assistants (47.7%), and nurses (29.5%). The most frequently reported training techniques were *structuring or simplifying tasks* and *providing feedback* (44; e.g. stepwise learning, rewarding, consistent coaching, correction of errors, and task repetitions), while *visual guidance* (31; e.g. written action plans, images, symbols, or pictograms) and *verbal guidance* (21; verbal instructions) were also frequently employed. Although abovementioned teaching techniques all allow the prevention of errors during the acquisition process, none of the facilities actually used this approach in this particular way. Sixteen respondents did mention *incidental learning,* including EF learning and 'discovery learning', in which methods cues are given but errors corrected afterwards.

Perceived benefits and drawbacks of skill relearning in dementia in general

Respondents judged that skill (re)training (whether or not using EL) was likely to increase the *autonomy* (47) and *wellbeing* (38) of people with dementia, and some (6) deemed patient *stimulation* an asset. With patients remastering tasks and skills, the *care burden* for nursing staff and informal caregivers (both 31) was assumed to be reduced, while five respondents noted that it was also likely to improve the quality of the patient-caregiver *relationship* (e.g. promoting more equality in the spousal roles).

Perceived benefits and drawbacks of EL

The professionals who perceived possibilities to incorporate EL into their practice, routines, and institution also saw opportunities to improve the quality of or expand their care services. By having people with dementia relearn tasks and skills or by modifying their behaviour using the EL approach, psychologists deemed they could improve the patients' *wellbeing* (9), while by training the use of a walking aid, for instance, the physiotherapist could help enhance their *mobility* (7), the occupational therapist their *autonomy* (2), and activity coordinators their *increasing engagement in leisure activities* (10). Some professionals (4) perceived that EL could foster a more positive and supportive *interaction* between nursing staff and residents with dementia and improve the *wellbeing* of the informal caregiver (8). With patients remastering tasks and skills using EL, 31 professionals reported the *care burden* for nursing staff and informal caregivers to be reduced, while five respondents noted that it was also likely to improve the quality of the patient-caregiver *relationship* (e.g., promoting more equality in the spousal roles). In contrast, other professionals of different disciplines judged EL to be time consuming and thus increase *burden,* with the highest burden perceived for nurses (30).

In addition to these somewhat contradictory findings on perceived burden for the caregivers, respondents proposed that the EL training process might be too great a *burden* (34) for the patient and too strong a confrontation with his or her limitations. Moreover, it might raise unrealistic *expectations* in both informal (8) and professional carers (3) (e.g., with respect to levels of regained independence or remediation of cognitive deficits). Even though EL was seen to entail a switch in procedures requiring flexibility and creativity, some respondents did not expect that having patients relearn tasks and skills using EL would have any disadvantages for themselves or their colleagues (4).

Implementation of errorless learning in dementia care

According to the respondents the most important skills likely to be best (re)learned using EL were *IADLs* (90) and *ADLs* (36), with skills relating to *orientation* (14; route learning, using a calendar), *mobility* (17), and *leisure activities* (18) also being mentioned relatively frequently. Occupational therapists (77.8%) and nurses (71.1%) were deemed best-equipped to deliver EL interventions, followed by physiotherapists (51.1%), activity coordinators (53.3%), psychologists (33.3%), and nursing assistants (24.4%). Sixty-nine percent of the respondents judged that the primary caregiver (i.e. spouse or family member) could play a *purposeful role*, for instance by helping train the patient to achieve the task using EL or by adopting a supportive (e.g. motivating and calming) stance (31.1%).

To assess the perceived feasibility of EL in clinical practice, we asked the respondents to approximate how much time professionals in each discipline would be able to spend on face-to-face training. Only nine respondents answered this specific question, estimating that all disciplines would be able to allot 1-5 hours over five days to EL sessions. The other respondents stated they were unable to give an estimation since training duration and intensity would be patient-specific. They did indicate that tasks could be practised repeatedly (69.8%) and over longer periods of time (82.9%). As to who should provide the EL interventions, respondents mentioned nurses (62.5%) most frequently, followed by occupational therapists (52.5%), activity coordinators (40%), and physiotherapists (35%).

Patient limitations (52) such as speech-language problems or apraxia were suggested as the main reason why the EL method would not be viable. Another prohibitive factor was that the respondents' facilities did not fulfil the *prerequisites* (17) for a proper implementation of EL, among which were time, financial, and staffing restraints, and that *implementation* would be *poor* (16; e.g. due to a lack of cooperation or communication between disciplines, or inconsistent training). In contrast, other respondents reported that their facility would afford *good implementation* (30) and that the *prerequisites* for successful EL were met (7; e.g. well-motivated staff, patient-tailored programmes, systematic approach by all disciplines). It was further noted that patients were likely to benefit from EL because it would engage their residual *capacities* in terms of their cognitive reserves (24). Almost all respondents deemed *communication and transfer* of the (new) EL working procedures attainable (95.3%), but only half assumed that other disciplines than their own would actually adhere to the same EL protocol (53.5%).

Evaluation and revision of the concept manual

Trial in care facilities

The survey respondents who had put the EL manual to the test by staging training sessions in their facility concluded it was indeed possible to teach people with dementia tasks or skills using EL (see Appendix B for the worksheets). A total of nine residents of two nursing homes and one private home took part; see Table 3.2 for details on patients, trainers, and skills trained. Interventions comprised between three and eight sessions lasting 15 to 30 minutes. Six trainers used additional visual cues, such as a step-by-step task script or coloured stickers on materials to help direct the patient's attention. All trainers mentioned that it was possible to prevent and to correct errors using the EL method. Seven of them reported that the patient was able to perform the task more independently than before the start of the training. The trainers praised the manual in that it helped them to focus on the patient's (residual) abilities rather than their cognitive deficits and (physical) limitations. It had enabled them to prevent the patient from making errors, with the manual providing clear clues for handling (near) errors. The manual had also facilitated (constructive, positive) interactions with the patient. Moreover, patients were motivated and training was successful despite their specific cognitive limitations. Patients rated the training sessions from neutral to very enjoyable (see Appendix C for the patient evaluation form).

In their feedback, trainers stressed the importance of patient-tailored training schemes. They mentioned an initial inconvenience with having to be consistent and directing towards their patient but soon found that it facilitated the learning process and that the patient was happy to be given clear, explicit instructions as this prevented hesitation, errors and anxiety. They also noted that, given their patient's severe cognitive impairments, having to be creative and flexible in their implementation of the protocol was demanding at times, but none indicated this to be a burden or a disadvantage of EL. They did mention that the time required to fully train the task or skill did pose a problem but solved the issue by integrating EL instructions and training in their routine or daily interactions with the patient and by involving colleagues from various disciplines. For an example of an EL pilot intervention, see Box 3.1.

Delphi round results

In this section the results obtained from the Delphi round using the AGREE questionnaire are described. A total of 19 AGREE forms, 11 of which were completed by the professionals who had piloted an EL intervention based on the concept manual; the other eight questionnaires were completed by the members of our expert panel (see Table 3.3 for contributor details). The domain scores (see Table 3.4) were calculated by summing up the scores for the individual items within a domain of all 19 forms and by scaling the total as a percentage of the maximum possible score for that domain. We did not stratify the scores for the two responder groups because of the small sample sizes.

Table 3.2 Characteristics of patients trained and EL training sessions provided

Aetiology	MMSE score/ dementia severity	Task	Training intensity	Delivered by
TBI	28, mild	Thicken beverages	6 sessions of 15-30 minutes	Psychologist
Alzheimer	18, moderate	Using a telephone	3 sessions of 30 minutes	Psychologist
Stroke	n/a, mild	Using an Mp3 player	6 sessions of 30 minutes	Occupational therapist
Mixed dementia	n/a, moderate	Learning a route	3 sessions of 15 minutes	Nurse practitioner
Alzheimer	n/a	Learning a route	3 sessions of 15 minutes	Nurse practitioner
Alzheimer	n/a	Learning a route	5 sessions of 20-30 minutes	Nurse practitioner
Mixed dementia	n/a	Making coffee	8 sessions of 15 minutes	Nurse practitioner
Alzheimer	23, mild	Making coffee	8 sessions of 15 minutes	Owner private residence
Alzheimer	n/a, severe	Checking paper to get the answer to a repeated question	8 sessions of 15 minutes	Nurse practitioner

Note: n/a, not available

BOX 3.1 Case example

Mrs B is a 73-year-old woman who lives at home with her husband. She was diagnosed with planning and executive dysfunction and mild attention and memory problems. She visits a day clinic for treatment three times a week. As she has difficulties swallowing, she needs to thicken her beverages but keeps forgetting how and when to do so. Her trainer hence proposes to help her to learn how to thicken beverages using an EL approach. Mrs B accepts and is eager and motivated.

Step-by-step task script
"How to thicken beverage"

1. *Take a glass*
2. *Fill the glass with the beverage*
3. *Take the container with thickening agent*
4. *Take the lid off the container*
5. *Pick up the measuring spoon*
6. *Put 1 measuring spoon of powder into the glass*
7. *Stir for 20-30 seconds*
8. *The beverage is now ready to be drunk*

The trainer next drafted a customized step-by-step plan. During training, Mrs B's key problem proved to be the amount of thickening powder needed and she evidently benefited from the strict structure the training procedure provided and the trainer's clear instructions and prompting. The trainer made sure to repeat the relevant step in case of (near) errors, hesitation, distraction, frustration, or confusion, after which he instructed Mrs B to repeat the entire sequence up to that point while providing additional verbal cues or assistance (e.g. by using modeling and physical guidance to support the verbal instructions).

After five 20-minute sessions, Mrs B was able to thicken her beverages unassisted. As she still had trouble reminding herself to do so, the trainer presented her with two drinking cups with the text 'thicken' written on them, to serve as a cue. The trainer also gave her the action script as a reminder and to enable her to check the steps and their sequence, which helped her to get started and to refocus after having been distracted.

When asked two weeks after training completion, Mrs. B reported she was doing well. She still occasionally forgot to thicken her beverages, but then had problems swallowing, which reminded her to add the thickener. Her husband also prompted her or reminded her to use the script, if needed. She no longer used the cups with the 'thicken' cues, but after the follow-up phone call from her trainer and some urging by her husband, she decided to start using them again.

The above case example is an adaptation of a case example presented in the EL manual: 'Errorless learning in dementia: a practical manual' *(de Werd, Boelen, & Kessels, 2014).*

All respondents stated they would recommend the EL manual and deemed EL a relevant approach to teaching people with dementia everyday tasks and skills. Scores for all domains were sufficient. Next, we will discuss the positive and negative comments per domain, with domain scores in parentheses.

The description of the *scope and purpose* of the manual was clear according to 17 respondents (87). Considering the *stakeholder involvement* domain (71), five respondents commented that too few disciplines had been involved in developing the manual, while again five found the manual lacking in its recommendations as to the professionals for which the EL protocol would be relevant. With respect to *clarity of presentation* (82), all respondents judged the working instructions to be clear and unambiguous. However, five respondents regretted that the manual did not address EL-related costs and organizational issues. As to its *applicability* (61) ten respondents' stated the manual lacked information on how to implement EL in terms of costs, while 12 respondents noted that the potential organizational barriers to successful implementation of the recommendations were sufficiently addressed. The question in the *rigour of development* (62) domain whether the manual substantiated an explicit link between its recommendations and the supporting evidence, was answered affirmatively by 11 respondents, with 13 respondents commenting that the manual did not contain information on how the results of the AGREE analysis would be used to revise it. Finally, there were some doubts about the *editorial independence* (60) in terms of conflicts of interests of the developers of the manual. The item 'competing interests of guideline development group members have been recorded and addressed' was rated negatively by nine respondents but none provided further explanation for their rating.

Table 3.3 Contributors to the Delphi round (AGREE instrument)

Manual evaluation	
Expert panel	**Survey respondents (pilot interventions)**
2 psychologists	7 psychologists
1 medical doctor	2 occupational therapists
1 activity coordinator	1 speech therapist
2 physiotherapists	1 nurse
1 speech therapist	
1 nurse	

Table 3.4 Results of the AGREE analysis

Domain	Domain score
Scope and purpose	87
Stakeholder involvement	71
Rigour of development	62
Clarity of presentation	82
Applicability	61
Editorial independence	60

The revised manual

Using the AGREE domain scores and the feedback from the professionals having run EL pilots and our expert panel, we refined the initial manual. Additions and changes comprised an introductory chapter on cognitive and, more specifically, memory deficits in dementia, an elaboration of the EL concept and its assumed working mechanisms, a review of the evidence for EL in dementia, and a chapter providing recommendations about the care disciplines in which EL could be applied as well as additional suggestions to boost training outcomes (e.g. time allocation, goal setting, motivating patients). The revised manual also includes anecdotes and case examples that had been provided by the survey respondents and Delphi round contributors. A summary of the revised EL manual can be found in Box 3.2.

BOX 3.1 Overview of the revised manual on errorless learning

The EL manual is a practical interpretation of the relevant literature, providing professionals in the dementia care domain with guidelines and detailed instructions on (re)learning people with dementia everyday skills using an errorless approach. The manual provides:

- An overview of the various dementia types, a cognitive model of memory, recommendations on memory functions to be addressed and teaching techniques to be applied to help optimize learning.
- An overview of the literature on EL:
  - review papers discussing EL-based training of relevant activities of daily living for people with dementia;
  - systematic evidence that adults with dementia can (re)learn relevant, everyday tasks using error-reducing techniques;
  - systematic evidence of the role of specific variables such as patient characteristics, dementia severity, type of task/skill suitable for (re)training, training intensity and duration, EL elements, outcome measures, experimental designs, and follow-up assessment.

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BOX 3.1 Continued

- The results of our feasibility survey among health professionals of various disciplines working in clinical geriatric care:
  - ensuring that the manual meets the needs of clinical practice as much and as effectively as possible;
  - showing that from the professionals' point of view there is a need for evidence-based guidelines and instruction on training techniques such as EL in geriatric care;
  - showing that the respondents anticipate multiple advantages of (re)learning individuals with dementia everyday tasks and skills and that EL is feasible in their patient population;
  - showing that the respondents perceive temporal, institutional/organizational and financial restraints that may hamper the implementation of EL in clinical practice.
- EL procedures and working instructions:
  - suggestions for task/skill selection, interdisciplinary transfer of and share in training interventions, and practical skill training plans (e.g. detailing goals, task scripts, practical arrangements/materials);
  - recommendations on time investment and handover to other disciplines;
  - detailed descriptions of error-reducing techniques and alternative combinations, implementation, ways to address (near) errors and hesitation in patients, and directions on how to fade out support after the skill or information has been mastered;
  - examples of step-by-step skill training plans and visual cues;
  - comprehensive examples of EL training programmes.
- The results of the Delphi round:
  - in an AGREE evaluation dementia experts and healthcare professionals working in residential geriatric facilities who had piloted a training as prescribed by the concept manual appraised the practicality, readability, and feasibility of the proposed manual and working instructions, which were judged to be clear and unambiguous.

Discussion

To explore the need for and feasibility of structured errorless learning approaches for adults with cognitive impairment due to dementia or other causes, we conducted a survey among professionals working in residential and specialized dementia facilities in the Netherlands, taking care to include all relevant disciplines. Most of the participating care residences already provided some skill training (e.g., through discovery or trial-and-error learning), but training was mostly unstructured and inconsistent. Respondents were most interested in adding EL to their toolkit or that of other disciplines and judged that helping residents to (re)learn everyday tasks or skills with the EL approach would be feasible within their facility.

We next developed a concept EL manual and had this implemented and evaluated in a Delphi round (AGREE analysis). The results and feedback from the professionals having piloted the protocol and the expert panel were, in general, very positive. They found the working instructions clear, comprehensible, and applicable in clinical practice, and all were pleased to recommend the manual to other disciplines involved in dementia care. Among the various benefits of EL they mentioned that, by creating a structured learning environment, both the trainer and the patient know what is expected of them, providing reassurance and reducing anxiety for both parties. EL was also suggested to improve the patient's mood and self-esteem. In their study of goal-oriented cognitive rehabilitation, Clare et al. (2010) also reported that personalized interventions had shown small improvements in quality of life.

Subsequently, we revised and expanded the EL manual based on the survey and Delphi round results and suggestions, which has recently been published (Dutch edition: de Werd, Boelen, & Kessels, 2013a; English edition: de Werd, Boelen, & Kessels, 2014). An outline of the EL manual and an example of a step-by-step training plan can be found in Box 3.2 and Figure 3.1, respectively. Furthermore, online instructional videos are available that show how a skill can be (re)trained without errors, what to do when the patient does make an error, and common trainer mistakes and their solution.

Despite being motivated to incorporate EL into their regular procedures, the survey and Delphi round respondents' main concern was a perceived lack of time to provide EL training for individual patients. Smit, Willemse, de Lange, and Pot (2014), however, suggested that it should be possible to offer people with dementia in nursing homes well-being-enhancing (leisure) activities with current staff levels and within existing budgets. The key factor here is to equip staff with the knowledge and skills they need to integrate these activities into their daily practice. The majority of our respondents judged themselves and their co-workers sufficiently motivated and flexible to successfully implement EL schemes. They indicated these two attributes as important prerequisites for incorporation EL into their current workload. For instance, once he or she has gained experience with the new procedure, it would not take a physiotherapist wanting to teach a individual with dementia to use a walking aid, for instance, much extra effort or time to do so using an EL rather than a trial-and-error approach. Moreover, structuring a patient's activities and strictly adhering to daily routines will expedite the learning process, reducing training time. Also, involving the informal caregiver in the training process will help cut the time professionals need to invest (Grandmaison & Simard, 2003). Our survey and Delphi round contributors already offered that informal caregivers might be instrumental in motivating and reassuring their spouse with dementia, as well as in actually assisting in training the skill using the EL approach in the residential or at home. In the latter instance it may help prolong the period people with dementia will be able to go on living in their own home, a desire of many dementia patients as well as their spouses or home carers (Kraijo, de Leeuw, & Schrijvers, 2015). Arguably, actively involving informal caregivers in skill (re)training would then also help keep our national dementia care services sustainable. Of course, future studies are needed to evaluate the clinical implementation of EL and our protocol, taking both the health and cost benefits into consideration.

Future research

To our knowledge this is the first study to explore the need for and feasibility of EL for use in dementia care and the first clinical EL manual that was developed based on information obtained from professionals working in the field. The efficacy and effectiveness of our manual will now need to be established, while further research should examine how EL interventions can best be integrated into clinical routines and determine what outcomes and quality indicators are most suitable to reliably evaluate their outcomes. Ongoing randomized controlled trials (Voigt-Radloff et al., 2011) are examining the efficacy of the EL approach as outlined in our manual. Future studies should not only focus on improvements in task performance, but also address the effects of our proposed EL approach on quality of life, self-efficacy, mood, and cognitive function of people with dementia. Also, potentially ameliorating effects on perceived stress levels of caregivers and families and improvement of their quality of life should be examined, as well as their cost-effectiveness, all compared to care as usual (see also Clare et al., 2013).

4 Train the trainer: Treatment adherence in errorless learning versus trial and error learning in teaching people with dementia everyday life tasks

Submitted as:

de Werd, M. M. E., Voigt-Radloff, S., Boelen, D. H. E, Olde Rikkert, M. G. M., Kessels, R. P. C., & Hüll. M. Train the trainer: Treatment adherence in errorless learning versus trial and error learning in teaching people with dementia everyday life tasks.

Abstract

This pilot study is part of the REDALI-DEM study, in which Errorless Learning (EL) is compared to Trial and Error Learning (TEL) in teaching people with dementia two everyday-life tasks at their homes. To date EL is carried out in various ways and no studies exist that have examined treatment adherence to carrying out a standardized EL manual. Therefore, the aim of this pilot study is to examine treatment adherence of therapists in both treatment arms (EL vs. TEL), with the aim to examine the feasibility of the developed EL and TEL manuals.

Prior to the start of the pilot study, an EL manual and a TEL manual were developed. Twenty-four therapists were trained on either the EL intervention or the TEL intervention. A repetition seminar resulted in some adaptations of the EL and TEL manuals (adapted manuals), with the aim to increase the feasibility of both teaching methods and the study protocol adherence. Treatment adherence of the therapists in both conditions was monitored using video observations of two treatment sessions (at the start of treatment sessions (v_{start}) and at the end of the treatment (v_{end})) and were rated on three items (therapeutic interaction, dealing with errors, and manual adherence) by two raters on a six-point scale.

Results showed excellent interrater reliability ($\rho = .66$, $p< .01$; ICC= 0.84, $p< .01$) with a 95% bias CI from .58 to.94). Therapists improved their treatment adherence over time (v_{end}: Median=3.5, v_{start}: Median= 5, z=-2.2, p<.05) and the overall treatment adherence was satisfactory for all therapists at the end of treatment (Total mean = 4.6; range= 3.00-12.50). There was no difference in the degree of treatment adherence between both intervention arms (EL vs. TEL). At the start of the treatment, therapists showed significantly better treatment adherence for the adapted manual than for the initial manual (U =105, z= - 2,18, p=-.029). There was no difference in treatment adherence at the end of treatment between the initial and adapted manual.

The results from this study show that performing a standardized EL protocol to teach people with dementia everyday-life tasks in their own home is feasible. The protocol proved to be flexible enough to apply EL in people with various degrees of dementia and in teaching a diversity of everyday-life tasks.

Introduction

People with Alzheimer dementia (AD) and their caregivers are faced with progressive deterioration of cognitive functioning. This leads to increasing problems in everyday-life functioning. Despite profound deficits in episodic and autobiographical memory, there is evidence that not all memory functions are affected to the same extent. Specifically, several studies have shown that procedural learning appears relatively preserved in mild and moderate AD (van Halteren-van Tilborg, Scherder, & Hulstijn, 2007). Optimizing these learning abilities might be of particular interest for relearning everyday tasks which could contribute to the patients' autonomy (van Tilborg et al., 2011). Errorless Learning (EL) is such a principle that uses (relatively) intact capacities of people with dementia, notably implicit learning (Baddeley & Wilson, 1994). EL is a teaching principle that uses feed-forward instructions in order to prevent people from making mistakes during the acquisition phase of learning. By preventing errors, only the correct responses are elicited and consolidated into memory. In contrast, trial and error learning (TEL) relies on an individual's problem-solving abilities. Also errors are made that have to be identified, corrected and retrieved from memory when faced with the task in the future. TEL thus relies on explicit memory and executive functions which are impaired in people with AD. Therefore, the assumption is that the prevention of errors during the acquisition of information or skills will facilitate learning in dementia. To apply EL, an active and guiding role from an instructor or therapist is necessary, for instance by using verbal instruction and modeling to clarify each step of a certain task, and the patient is invited to perform each of these steps. The method of Vanishing cues can be applied to gradually decrease the amount of modeling and verbal instructions (de Werd, Boelen, Olde Rikkert, & Kessels, 2015; de Werd et al., 2013b).

Various studies have examined the efficacy of EL compared to TEL or no treatment. In these studies mostly artificial tasks were used with little or no relevance for patients in daily life (e.g., word-stem completion tasks or arbitrary face-name association paradigms). These studies showed, compared to TEL or no training, a beneficial effect of EL training after three to six months in patient with dementia (Clare & Jones, 2008; Kessels & de Haan, 2003; Middleton & Schwartz, 2012). The effectiveness of EL in learning real-life tasks has been also examined in a few tasks showing positive results compared to TEL or no treatment, even at follow-up in several cases (de Werd et al., 2013b). However, so far these studies have examined the effects of EL in small patient groups or using single-case studies. Also, tasks were not always trained in the patients' natural or home environment, which limits the external validity of these studies.

In a multi-site Randomized Controlled Trial (RCT) we aim to evaluate the effects of EL vs. TEL on the performance of relevant daily life tasks in people with mild to moderate dementia living at home (Voigt-Radloff et al., 2011). Prior to the RCT, a pilot study was performed, for which standardized manuals for both EL and TEL teaching methods were developed (de Werd et al., 2015). Therapists were carefully instructed to perform either teaching method. Treatment adherence of the therapists in each learning condition was monitored using video observations of two training sessions. The therapists received detailed feedback on their training performance.

The evaluation of treatment adherence is an important factor when examining the feasibility of the developed EL and TEL manuals. To date, EL interventions are carried out in heterogeneous ways and no studies exist that examined treatment adherence of such a standardized EL protocol, applied in various degrees of dementia and in teaching Instrumental Activities of Daily Living (IADL) at peoples' home. Secondly, it is important that both training interventions (EL and TEL) are carried out properly since this is of influence on primary outcome measures in the REDALI-DEM RCT study; the EL effect compared to TEL (Voigt-Radloff et al., 2011). Therefore, the aim of the current pilot study is to examine treatment adherence of therapists in both groups (EL vs. TEL).

Methods

Participants

The current pilot study was part of the REDALI-DEM project in which two instructional methods on teaching people with dementia two daily life tasks are compared. For further details we refer to the REDALI-DEM study protocol (Voigt-Radloff et al., 2011). In this pilot study, therapists were recruited from seven outpatient memory centres from university hospitals in Germany. A total of 24 therapists were included, one of whom had dropped out (this therapist did not want to follow a study protocol). Table 4.1 provides details on the therapists.

Intervention protocols

Prior to the start of the pilot study two manuals were developed (i.e., EL and a TEL) in which therapists received elaborate instruction. Both manuals contained general information on the background of the study, examples of optional treatment, how to choose an appropriate task, how and when to videotape the performance of the participants, the amount of treatment sessions and the duration of each treatment. Details on the development of the EL manual have been published elsewhere (de Werd et al., 2015).

Errorless learning treatment procedure

The EL teaching instruction was based on the EL method used in a previous study on EL of everyday activities in dementia and a literature review (de Werd et al., 2013b; Dechamps et al., 2011), and was further sophisticated during the pilot phase. The EL manual describes how therapists can teach everyday tasks in such a way that the occurrence of errors is being prevented or minimized. First, each task was divided into core elements (see Table 4.2).

A core element is defined as a series of task steps that are grouped in a logical way. For more details on the core element methods we refer to a previous publication (de Werd et al., 2016). EL encompasses preventing errors by actively guiding the patient through the

Table 4.1 Characteristics of the main therapists for the errorless learning (EL) and trial and error learning (TEL) arms, as well as substitute therapists (for both EL and TEL)

Study centre	Age	Profession	Years in the field	Complete Cases trained	Incomplete Cases (drop out)
Main Therapists EL					
Bonn	43	OT	5	2	1
Freiburg	48	OT	10	2	0
Mainz	43	OT	9	2	1
Marburg	26	Psych	1	1	0
Tübingen	43	OT	18	2	0
Tübingen	56	OT	14	1	0
Heilbronn	27	OT	3	1	1
Mannheim	35	OT	3	1	1
Main Therapists TEL					
Bonn	34	OT	6	2	1
Freiburg	30	OT	6	2	0
Mainz	28	Psych	1	2	1
Marburg	38	OT	15	2	0
Tübingen	28	Psych	4	2	0
Tübingen	48	Nurse	12	0	1
Heilbronn	53	OT	15	2	0
Mannheim	55	OT	11	0	1
Mannheim	29	OT	4	1	0
Substitute Therapists (for both EL and TEL)					
Bonn	26	OT	3	2	0
Freiburg	46	OT	3	2	1
Mainz	27	Psych	1	2	0
Marburg	32	Psych	2	2	1
Heilbronn	39	OT	5	0	1
Mannheim	57	OT	12	0	1
Mannheim	26	OT	3	2	0

Note. OT = occupational therapist; Psych = master-degree psychologist

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Table 4.2 Example of an activity divided into different core elements

	Making a phone call			
Core element	***Get the number***	***Dial the number***	***Make conversation and end call***	***End task***
Possible steps	- Take a phone book or mobile phone - Search the telephone number in the mobile phone or phonebook - Write the number on a piece of paper	- Press the correct numbers on the telephone to dial the number - Select the correct name in the telephone book of the telephone - Press the right button to make the telephone call	- Talk into the telephone - Talk into the phone by using the 'speaker' function - End the call by pressing the correct button	- Place the telephone back in the right position - Put away the telephone book or paper

task at hand and making sure that only correct responses are given. This can be achieved by modeling the task steps combined with verbal and/or physical instructions and prompting and carefully anticipating errors in each task step. In case of hesitation or (near-) errors the therapist has to intervene immediately by modeling and prompting the step again, repeating it until no hesitation or errors occur anymore. Not until each of the steps and core elements are mastered this way, with a minimum of six treatment sessions per task, help and support is faded out.

TEL treatment procedure

In the TEL manual, patients are instructed to actively perform the task. Crucial difference with EL is that patients are allowed to make errors and self-corrections. In the TEL condition therapists are instructed to intervene as little as possible, thereby stimulating the patient's problem solving abilities. Therapists are instructed not to intervene or prompt during the first ten minutes (no matter how many errors the patient makes) of a treatment session. Then, only general hints or questions are asked to further stimulate problem solving by the patient. Only if steps are not performed correctly, help is provided so that the patient can move on to the next step. Nevertheless, irritability and anxiety is monitored and prevented as much as possible.

Procedure

In this pilot study, therapists were recruited from seven outpatient memory centres from university hospitals in Germany. Inclusion criteria for all patients were (1) diagnosed with AD or mixed-type dementia; (2) Mini-Mental State Examination between 14 to 24; (3) living at home; (4) carer available; (5) at least moderate need for assistance in IADL as defined by the Interview for Deterioration in Daily Living Activities (IDDD; Teunisse & Derix, 1997). For more details on the study protocol see (Voigt-Radloff et al., 2011). After random allocation of the patients to one of the learning conditions (EL vs. TEL) the therapists could start with the protocol.

The first and second session were used to select an appropriate task to train. During a face-to-face interview with the patient and his or her caregiver, two tasks were selected that were relevant for the patient in daily life, but which he/she was no longer able to perform independently. To prevent floor and ceiling effects a task was only selected if patients were able to successfully perform at least one core element, but no more than two core elements of the task. The patient and his/her caregiver could choose from a catalogue containing 21 tasks that were pre-selected and described by the authors (see also (Voigt-Radloff et al., 2011). A baseline video of the task performance was made in session three. (Re-)learning the tasks with either EL or TEL started in session four. This second and second last treatment session was videotaped to assess treatment adherence by the therapist

Training the therapists

Seminar 1

A seminar was held to train the therapists on either the EL intervention or the TEL intervention, prior to the pilot data collection. The intervention seminars were separated in time, in order to prevent contamination of specific seminar content between the TEL and EL group. The intervention procedures and manuals were explained. Practice took place through role-plays. Each study site also provided one therapist that was taught to apply both EL and TEL and could serve as a substitute in case of holidays or illness (with the exception of one study site which could involve two separate "non-contaminated" substitutes, one for EL and one for TEL). Therapists and patients were not blind for the type of intervention (EL or TEL). However, neither the patients nor the interventionists were explicitly presented an hypothesis on which intervention may be more likely to improve performance of activities of daily living. For that reason the names of the two conditions were changed in this study (i.e., guided learning (EL) and active learning (TEL).

Repetition seminar

Six months after the initial seminar a repetition seminar was held. Each therapist had had the opportunity to treat two patients and received feedback on their treatment performance through the treatment videos they recorded at the start and at the end of the. Both this feedback and practical issues and difficulties that the therapists had encountered were discussed, again in separated seminars for EL and TEL conditions. Consequently, some adaptations in study procedure and EL and TEL manuals were made aiming to increase the feasibility of both teaching methods and the study protocol adherence.

Monitoring treatment adherence

In each patient two tasks were trained and videotaped at the start of treatment sessions (v_{start}) and at the end of the treatment (v_{end}). Two neuropsychologists (MdW and DB) from Radboud University Medical Center in Nijmegen, the Netherlands, assessed the quality of treatment by the therapist on three items: therapeutic interaction, dealing with errors, and manual adherence. Each of these items was scored on a 6-point scale with: 1 reflecting an excellent job and 6 a poor treatment (1= excellent, 2= good, 3= adequate, 4= sufficient, 5= insufficient, 6=poor). Each assessment was also provided with detailed feedback that was sent to the therapist so they could improve their performance. After the last treatment session, therapists also rated themselves on the same three items using the same six point scale.

Analysis

First, ratings between the two activities were averaged per item (i.e., therapeutic interaction, dealing with errors, and manual adherence). For data reduction purposes, we computed the total score for each assessment ($v_{start,}$ $v_{end,}$ self-rating). For all subsequent analyses, the total scores were used. As all ratings are ordinal in nature and not normally distributed, we performed nonparametric analyses throughout.

Eighteen v_{start} were doubly rated by the two raters and , interrater reliability was computed using Spearman's ρ, to examine the relation between both raters and intra-class correlations (ICC) to investigate the consistency between both ratings. Next, we examined the difference between the ratings of v_{start} and v_{end} using Wilcoxon's signed rank test. The agreement between the self-ratings and the ratings of v_{end} (which was closest to the time point of the self-rating) were analysed using Spearman's ρ and ICC. Furthermore, we examined whether the adherence ratings differed between the two learning conditions for v_{start} and v_{end} using a Mann-Whitney U test. To examine the difference between treatment adherence of the 'initial' manuals and the 'adapted' manuals, also a Mann-Whitney U test was performed.

To evaluate the therapist's level of performance at v_{end}, the total mean of the ratings on the three items (therapeutic interaction, dealing with errors, and manual adherence) was computed, with a mean score of three (a score of 1 on each of the three items) showing excellent treatment adherence and a score of 18 (a score of 6 on each of the three items) a very poor treatment adherence.

Results

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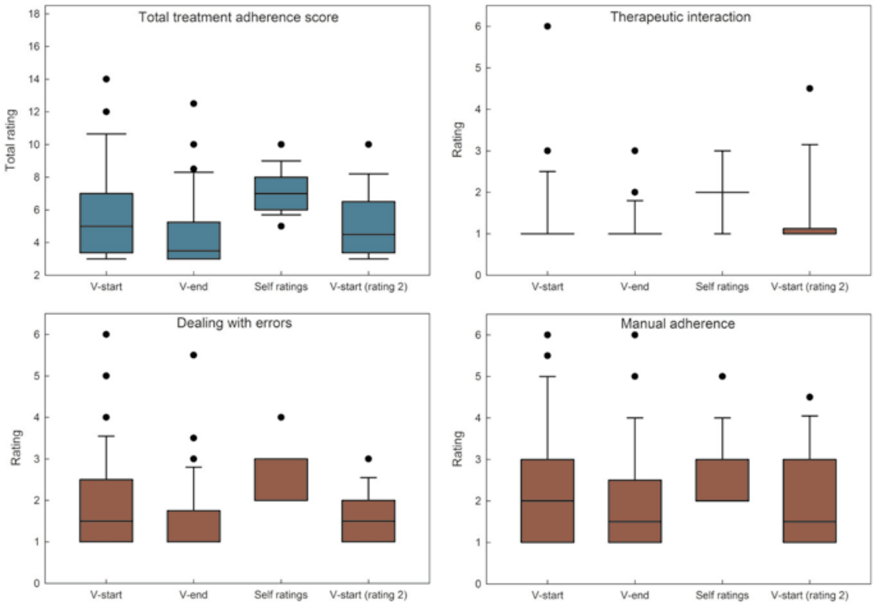
A total of 24 therapists who treated 49 patients were included. Eleven patients dropped out before the actual start of the treatment (four patients had no motivation, seven patients no appropriate task to train). Eventually, 38 v_{start} treatment videos (each video contained 2 activities) and 33 v_{end} treatment videos were rated for this study. Fifteen patients were trained on the 'initial manual and 18 patients were trained on the 'adapted' manual. For v_{end} there were five missing videos; three EL v_{end} and two TEL v_{end} (three missings due to procedural problems and two missings due to drop out of the patient). Thirty-six self-ratings were available. One missing was due to drop out of the patient and one therapists forgot to fill in the self-ratings form. In figure 4.1 the median and range of the scores of v_{start} and v_{end}, self-ratings and the rating of the second rater for v_{start} are shown.

Spearman analysis showed that the ratings of rater one were highly correlated with the ratings of rater two, ρ = .66, $p< .01$. The ICC was 0.84 ($p< .01$) with a 95% bias CI of from.58 to.94, showing an excellent consistency between both raters.

A Wilcoxon signed rank test indicated that ratings at v_{end}, Median=3.5, were significantly better than at v_{start}, Median= 5 z=-2.2, p<.05, showing that therapists improved their treatment adherence. Self-ratings done by the therapist did not correlate with the ratings from the independent raters, ρ = .261, *ns*. Subsequently the ICC indicated that there was no consistency between the independent raters and the self- ratings by the therapists. The ICC was .251 (*ns*) with a 95% bias CI of from-.517 to.630. In general therapists (Median=

7.00) rated their treatment adherence lower than the independent raters did (Median=3.5). Treatment adherence in the EL group (Median= 5) did not significantly differ from treatment adherence in the TEL group (Median=5) at v_{start}, *U*=172.5, *z*=-.24, *ns* and v_{end} (EL group: Median=3.75; TEL group: Median=3.50; *U*=129, *z*=-.26, *ns*.).

A Mann-Whitney U test showed a better treatment adherence at v_{start} for therapists who used the 'adapted' manual than for therapists who used the 'initial' manual *U* =105, *z*= - 2,18 *p*=-.029. At v_{end} there was no difference in treatment adherence between the initial and adapted manual *U*=106,50, *z*=-1.05, *ns*. Finally, at v_{end} all therapists were able to perform the intervention (EL or/and TEL) satisfactorily (Total mean = 4.6; range= 3.00-12.50).



The horizontal lines represents the median. The bottom and top of the box show the 25th and 75th percentile respectively. The whiskers represent the variability outside the upper and lower quartiles. The dots represent the outliers.

a. Left-top panel. Total adherence score on all four measurement points.
b. Left-bottom panel. Score for dealing with errors on all four measurement points.
c. Right-top panel. Score for therapeutic interaction on all four measurement points.
d. Right-bottom panel. Score for manual adherence score on all four measurement points

Figure 4.1 Treatment adherence score for v_{start} and $v_{end,}$ self ratings and the ratings of the second raters presented in boxplots.

Discussion

The aim of this study was to examine treatment adherence of therapists who were instructed to apply either of two IADL treatment interventions (EL or TEL). This is, to our knowledge, the first study that examined the feasibility of carrying out a standardized EL protocol. The results of this study were used to optimize both EL and TEL manuals, but were also used to optimize study procedures before the start of a large, multicentre intervention trial (REDALI-DEM RCT; Voigt-Radloff et al., 2011).

Results showed that the two raters agreed in the assessment of the therapists. Therapists improved their performance in both interventions from the start of the intervention until the end of the intervention and the overall performance of the intervention was satisfactorily for all therapists at the end of the treatment. There was no difference in the degree of treatment adherence between both interventions (EL vs. TEL). At the start of the intervention, the therapists showed significantly better treatment adherence for the 'adapted' manual than the 'initial' manual. However, there was no difference in treatment adherence at the end of the intervention between the 'initial' and 'adapted' manual. This result shows that it was easier for therapists to apply the intervention instructions of the adapted manual at the start of the treatment compared to the initial manual. Finally, the findings demonstrate that therapists rated themselves worse than the two raters did. It is possible that therapists are more humble when they have to rate their own performance which would clarify this difference.

Earlier studies have examined EL in laboratory studies or in studies using a variety of EL procedures, since there was no standardized protocol available (de Werd et al., 2013b). Furthermore, these studies did not examine the treatment adherence of the EL intervention. The results from the current study clearly indicate that it is possible to perform a standardized EL protocol to teach people with dementia everyday-life tasks in their own home. The protocol proved to be flexible enough to apply EL on people with various degrees of dementia and in teaching a diversity of everyday-life tasks. The results from this study also show that this flexibility has no effect on the quality of carrying out the EL intervention.

Moreover, this study shows the importance of carrying out a pilot study before the start of an RCT. Adaptations and changes to study protocols during an RCT are not desirable since this obviously affects study outcome measures and can be as such be considered protocol violations. The fact that this study shows that the developed manuals are feasible and all therapists showed a good treatment adherence is therefore of great value for the start of the REDALI-DEM RCT, and more in general for future studies examining EL in teaching people with dementia IADL at their homes.

Conclusion

To our knowledge, this is the first study that evaluates treatment adherence of EL and TEL interventions to teach everyday-life skills in patients with dementia in their own environment. Treatment adherence did not differ between both interventions. The adaptations to the 'initial' manuals resulted in 'adapted' manuals and improved treatment adherence at the start of treatment and thus enabled therapists in better treatment performance right from the beginning. The protocol proved to be flexible enough to apply EL on people with various degrees of dementia and in teaching a diversity of everyday-life tasks. The results also show that this flexibility has no effect on the quality of carrying out the EL intervention.

5 Interrater reliability and concurrent validity of a new rating scale to assess the performance of everyday life tasks in dementia: the Core Elements Method

Published as:

de Werd, M. M. E, Hoelzenbein, A. C., Boelen, D. H. E., Olde Rikkert, M. G. M., Hüll, M., Kessels, R. P. C., & Voigt-Radloff, S. (2016). Interrater reliability and concurrent validity of a new rating scale to assess the performance of everyday life tasks in dementia: The Core Elements Method. *American Journal of Alzheimer's Disease and Other Dementias, 31*, 605-611.

Abstract

Errorless Learning (EL) is an instructional procedure involving error reduction during learning. EL is mostly examined by counting correctly executed task steps or by rating them using a Task Performance Scale (TPS). Here, we explore the validity and reliability of a new assessment procedure; the Core Elements Method (CEM), which rates essential building blocks of activities rather than individual steps. Task performance was assessed in 35 Alzheimer's dementia patients recruited from the REDALI-DEM study using TPS and CEM independently. Results showed excellent interrater reliabilities for both measure methods (CEM: ICC=.85; TPS: ICC=.97). Also, both methods showed a high agreement (CEM: Mean of Measurement Difference [MD]=-3.44, *SD*=14.72; TPS *MD*=-0.41, *SD*=7.89) and correlated highly (>.75). Based on these results TPS and CEM are both valid for assessing task performance. However, since TPS is more complicated and time-consuming, CEM may be the preferred method for future research projects.

Introduction

Dementia causes progressive loss of various cognitive functions, including memory, executive functioning and language abilities. Also, loss of social skills and initiative are major problems that occur in dementia. This leads to an inability to function independently at home and perform daily activities, affecting quality of life. Dementia due to Alzheimer disease in particular, is responsible for high health-care costs and burdens patients and their primary carers. Cognitive rehabilitation (CR) programs and occupational therapy focus on maintaining quality of life despite the deficits that are likely to progress over time. CR interventions aim to increase the patients' autonomy and decrease caregiver burden by exploiting compensatory and restorative strategies and may comprise adaptations of the environment, the use of external aids, and interventions to relearn specific skills (Olazaran et al., 2010; Viola et al., 2011).

One example of a potentially successful non-pharmacological intervention is Errorless Learning (EL; Clare & Jones, 2008; Grandmaison & Simard, 2003). The basic assumption of EL is that errors made during the acquisition phase of learning a task may interfere with correct responses during the later retrieval of what is learned. Due to explicit memory deficits and self-monitoring problems, these errors are not recognized and corrected, but may be consolidated in memory in an implicit, automatic way (Baddeley & Wilson, 1994). The prevention of errors during learning has been demonstrated to be a promising technique in the cognitive rehabilitation of patients with dementia and its application in clinical practice involves a combination of teaching techniques aimed at reducing the amount of errors made during acquisition as much as possible (Clare & Jones, 2008; de Werd et al., 2013b).

Recently, EL has been increasingly used in teaching patients with dementia (Instrumental) Activities of Daily Living (I)ADL, using various outcome measurements (de Werd et al., 2013b). To date, the assessment of IADL functioning in patients with dementia is mostly limited to informant-based IADL questionnaires (Desai, Grossberg, & Sheth, 2004; Sikkes et al., 2012; Teunisse & Derix, 1997). In a systematic review of dementia specific informant questionnaires, 12 IADL questionnaires were rated on eight psychometric properties. Information was lacking for many important measurement properties, such as the content validity, internal consistency, and reproducibility (Sikkes, de Lange-de Klerk, Pijnenburg, Scheltens, & Uitdehaag, 2009). Another disadvantage is that these questionnaires mostly rely on informant's view on IADL performance which is not always reliable and accurate (Jorm, 2004). Furthermore, the aim of these questionnaires is to provide an overall view on daily life functioning for diagnostic reasons; therefore, these instruments do not provide information on the quality of performance of specific IADL (Sikkes et al., 2009). Hence, there is a need for a more objective and quantitative measure of IADL functioning in patients with dementia. Performance-based assessment provides such an objective behavioural evaluation of functional skills by observing directly an individual enacting an

IADL. One such example of a performance-based measure for IADL is the Functional Living Scale Assessment (FLSA) developed by Farina and colleagues (2010). Here, the quality of performance was derived from the level of assistance needed by the patient to carry out the task. These authors found a good interrater and a sufficient test-retest reliability and recommended this scale to use in a diagnostic setting and in rehabilitation. However, the FLSA consists of a pre-set areas of interest and items, limiting its use to these included tasks. Alternatively, automatic video monitoring systems can be used to obtain a performance-based measure (Konig, Crispim-Junior, et al., 2015a; Konig, Crispim Junior, et al., 2015b; Robert et al., 2013). Here, the amount of initiated and/or completed activities, and duration of task completion, is measured by an Event Monitoring System (EMS). EMS measures task performance by automatic computer-based video analysis. It is therefore presumed to be less time consuming for raters and more accurate and objective than rater-based IADL questionnaires or observations. Study results suggest that it is possible to quantitatively assess IADL functioning supported by an EMS and that even based on the extracted data the participants could be classified in groups (healthy controls, MCI and Alzheimer) with high accuracy (Konig, Crispim-Junior, et al., 2015a). EMS can thus contribute to diagnostic decision making and serve as a measure for therapeutic evaluation in rehabilitation. One disadvantage of EMS is that it does not provide information about the quality of the individual steps performed as part of the task (but basically 'checks' the order and duration of the task steps in an automatic manner).

Although FLSA and EMS are promising examples of performance-based measures, both methods have their limitations. One method that may overcome these problems is the Task Performance Scale (TPS). This entails the rating of individual task steps, which takes into account both the accuracy and order of these steps. TPS can be used for any self-chosen activity of daily living independent of the study setting (e.g., in the patient's home environment, a rehabilitation setting or in a nursing home). TPS has been examined in dementia patients in a study of Dechamps and colleagues (2011) and was also investigated in adults with acquired brain injury (Bertens, Fasotti, Boelen, & Kessels, 2013). In an ongoing Randomized Controlled Trial (RCT) EL is compared with Trial and Error Learning (TEL) in teaching patients with dementia two everyday-life tasks (Voigt-Radloff et al., 2011). While each of the above mentioned rating methods seemed adequate for determining the efficacy of EL, they have not been investigated on reliability and construct validity in a naturalistic setting such as peoples' homes while the patient is performing relevant daily life tasks. Therefore, in this study the Core Elements Method (CEM) is introduced, for two reasons: (1) to assess task performance in both treatment arms of relevant everyday tasks at patients' homes and (2) to divide tasks into structured steps that can be easily taught and repeated several times during training sessions in a standardized way. A core element is defined as a series of task steps that are grouped in a logical way. Tasks are a-priori subdivided into core elements, which are used as building blocks to teach tasks on the one hand and are used for rating performance afterwards.

The aim of this study was to explore the validity and reliability of CEM as an assessment tool for rating IADL task performance in patients with dementia. Therefore the interrater reliability of CEM and TPS was analysed and compared. Secondly, the concurrent validity of CEM in comparison to TPS was analysed.

Methods

Participants and task selection

Participants were recruited from six outpatient memory centres from university hospitals in Germany. Inclusion criteria for all participants were (1) diagnosed with Alzheimer's dementia or mixed type dementia; (2) Mini-Mental State Examination between 14 to 24; (3) living at home; (4) carer available; (5) at least moderate need for assistance in IADL as defined by the Interview for Deterioration in Daily Living Activities (IDDD; Teunisse & Derix, 1997). Patients who fulfilled these criteria were selected by psychiatrists and neurologists working in the participating study centres. The selection of tasks and the training sessions were performed by psychologists and occupational therapists and took place at patients' homes. For the current validation study we sampled the post-treatment evaluation videos of 35 patients who were enrolled in the RCT and had been allocated to the EL condition. The planned sample size for the EL condition in the RCT was 88 participants. The ethics committee of the Freiburg University approved the study. For more details we refer to the study protocol of the REDALI-DEM study (Voigt-Radloff et al., 2011).

During a face-to-face interview with the patient and his or her caregiver, two tasks were selected from a catalogue containing 43 tasks that were pre-selected and described by the authors. Each task was divided into four to five core elements (see table 5.1 for an example). It was important to select a task that (1) was relevant for the patient, (2) the patient was no longer able to perform independently, but for which still some residual task performance was left. Therefore, a task was only selected when patients were able to successfully perform at least one, but no more than two core elements of the task. Another task was selected if the patient failed these criteria. If none of the 43 pre-selected tasks were relevant of suitable for the patient, another task could be chosen and was added to the catalogue. For more details we refer to the study protocol of the REDALI-DEM study (Voigt-Radloff et al., 2011).

5

Procedure

The REDALI-DEM study compared two instructional methods in teaching patients with dementia two daily life tasks, i.e. EL and TEL. Performance of the two selected tasks was videotaped at baseline (t_0), after the first intervention block at 11 weeks (t_1), at follow-up 16 weeks after having completed the intervention (t_2), and 26 weeks after having completed the intervention (t_3, see table 5.2). For further details we refer to the REDALI-DEM study protocol (Voigt-Radloff et al., 2011).

Table 5.1 Example of an activity divided into different core elements

	Making a phone call			
Core element	***Get the number***	***Dial the number***	***Make conversation and end call***	***End task***
Possible steps	- Take a phone book or mobile phone - Search the telephone number in the mobile phone or phonebook - Write the number on a piece of paper	- Press the correct numbers on the telephone to dial the number - Select the correct name in the telephone book of the telephone - Press the right button to make the telephone call	- Talk into the telephone - Talk into the phone by using the 'speaker' function - End the call by pressing the correct button	- Place the telephone back in the right position - Put away the telephone book or paper

Table 5.2 Intervention scheme

Weeks	**0-2**	**3-10**	**11**	**16***	**19-20**	**26**
Measurement	t_0		t_1	t_2		t_3
Intervention		9 sessions		break	2 refresher sessions	

* Primary measurement time point

Design

The two rating methods CEM and TPS were compared using a random sample of 70 EL evaluation videos at t_2, coming from 35 patients with Alzheimer's dementia (AD), each of whom had chosen two tasks to relearn (Voigt-Radloff et al., 2011). There were no patients excluded for this paper. Only EL evaluation videos were chosen because the aim of the current study was to examine the assessment capabilities of CEM and TPS as rating methods and not the training effects of EL on task performance. Importantly, the assessment procedure for the EL and TEL videos did not differ, which makes that the reliability results of the present study can be generalized to both procedures.

Rating with the Core Elements Method (CEM) was taught to fourteen independent raters in a one-hour training. These were students from the University of Freiburg without a background in neuropsychology or knowledge of geriatrics. The to-be-rated videos were randomly allocated to two raters (from the group of fourteen raters) immediately after videotaping at t_2, resulting in each video being rated twice. The same rater could not rate the same video twice.

Another two independent raters were chosen to rate the evaluation videos using the Task Performance Scale (TPS; Dechamps et al., 2011). These were both neuropsychologists with clinical experience in the geriatric population and familiar with EL and with the TPS method. The two raters of the TPS method each rated all 70 t_2-evaluation videos within a short period of time. CEM and TPS ratings were performed by different raters to prevent for possible influences that could affect their ratings. For pragmatic reasons CEM was scored by novices and therefore they received a one-hour training contrary to the raters of TPS who were already experienced with the TPS method.

Outcome measures

Core Elements Method

The therapists were provided with a catalogue of daily tasks that were subdivided into core elements and illustrated with detailed descriptions (see table 5.1 for an example). The core elements were used as a stepwise approach to teach patients the tasks they had chosen. The same catalogue with core elements was used for rating performance after the training had ended by independent raters. Before rating the videos, each of the two raters consulted the catalogue that after training could contain additional detailed notes provided by therapists. An example of such a personalized detail might be that while the catalogue description for searching telephone numbers mentioned: "Search for the number in the mobile phone or phonebook", the therapists' additional note might state: "number is searched in a personal address book". In some cases the standard task was altered and tailored to individual routines of patients by adding or deleting specific steps, which nonetheless related to the task goal. An example of such a modified instruction is "talk into the telephone by using the 'speaker' function". The performance quality was rated on each core element using a 7-point scale for each task, (1 = not performed at all as trained by the therapist; 7 = performed exactly as trained by the therapist). To determine the performance quality, raters could consult the provided notes of the therapists. For the sake of comparison with the TPS assessment method, a mean performance score of the individual ratings of core elements of each task was calculated and converted to a percentage (number of correctly performed elements as a proportion of total number of elements in a task).

Task Performance Scale

For each task the TPS-raters wrote a script consisting of a sequence of steps that led to the stated task goal (see table 5.3 for a script example). These scripts were discussed and consensus was reached between both raters about the necessary steps for each task, as well as their logical order (i.e. leading to the stated goal). The videos were then scored independently by the two raters using the following scores for each task step: (1) competent; (2) questionable/ineffective; (3) deficit.

- **Competent (score=2)**. The step was performed successfully and executed in the correct or logical order.
- **Questionable/ineffective (score=1)**. The step was not performed correctly or completely, steps that has already been performed were repeated, actions unrelated to the activity were performed, or hesitations were shown verbally (e.g., by asking 'is this correct?') or physically (e.g., wavering or faltering), or the step was not carried out in the correct order (e.g., putting on shoes and coat to go shopping before writing a shopping list).
- **Deficit (score=0)**. This score designates the absence of a response or a reaction.

Optional steps (such as using the speaker function to talk into the phone) were only rated if performed. Since these steps were not necessary to reach the stated task goal, they were not rated as a deficit when a patient did not show them. Inevitably this lead to various amounts of rated steps between participants performing the same activity. A mean performance score using the individual ratings of each task was calculated and converted to a percentage to be able to compare the tasks to each other and to CEM-scores. Thus, the total score for each task was the number of correctly performed steps as a proportion of total number of steps in that task.

Statistical analyses

Interrater reliability analyses

An interrater reliability analysis using intra class coefficient (ICC) was performed to determine the degree of consistency between the CEM raters and between the TPS raters. The ICC will be high if there is little variation between the scores given to each item by raters of the same assessment method (CEM or TPS). ICC values between 0.4 and 0.75 represent reasonable to good reliability and ICC values greater than 0.75 represent excellent reliability

Table 5.3 Example of a task script

Using a telephone
Take the telephone
Look on the paper/telephone for the correct number
Dial the number/choose the right number
Make a conversation
Switch off the phone Optional step: Put the phone back
Optional step: Talk into the phone by using the 'speaker function'

(Fleiss, 1986). As the ICC only demonstrates the overall agreement between raters, we examined potential absolute differences among the CEM raters and the TPS raters using Bland-Altman plots and one sample t-tests (Bland & Altman, 1999). Here, the mean difference should not significantly differ from zero to indicate interrater agreement.

Concurrent validity analyses

To examine the concurrent validity between CEM and TPS, Pearson correlations between the ratings of CEM and TPS were calculated. A high correlation suggests that the score of CEM ratings are highly related to the scores of TPS ratings. It also indicates that both methods are measuring the same construct.

Results

A total of 35 patient outcome videos (from 19 women and 16 men) were rated, resulting in 70 rated task performances (two tasks per patient). Mean age of the patients was 81.0 years (SD= 6.6). The mean MMSE score of these participants was 19.2 (SD= 4.7).

Interrater reliability of the CEM

The CEM ratings resulted in an ICC of .85 with a 95% confidence interval from .77 to .90, $F(69, 70)=12.28$, $p<.001$. Figure 5.1 shows the Bland-Altman plot; the mean of the measurement difference between the CEM raters (MD= -3.44, SD= 14.72) did not differ significantly from zero ($t(69)=-1.95$), with a scoring range between 14.3 and 100.

Interrater reliability of the TPS

For TPS, the ICC was .97 (95% confidence interval: .95 - .98, $F(69,69)=69.57$, $p<.001$). Figure 5.2 shows the Bland-Altman plot of TPS-ratings. The mean of the measurement difference between the TPS raters (MD= -0.41, SD= 7.89) did not significantly differ from zero ($t(69)=-0.44$). The raters used the whole scoring range on the TPS (scores between 0 and 100).

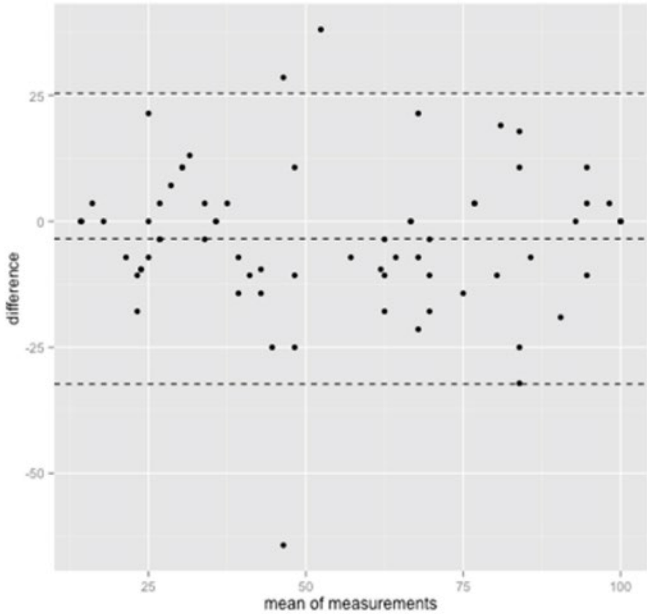


Figure 5.1 Bland-Altman plot for the agreement in the ratings with the CEM method.

Every point represents a data point, each assessed by the two measurements. The abscissa displays the mean of the two measurements. The ordinate displays the difference between the two measurements. The dotted line in the middle represents the absolute mean of the differences. The outer two dotted lines represent the mean plus/ minus 1.96 times the standard deviation of the difference.

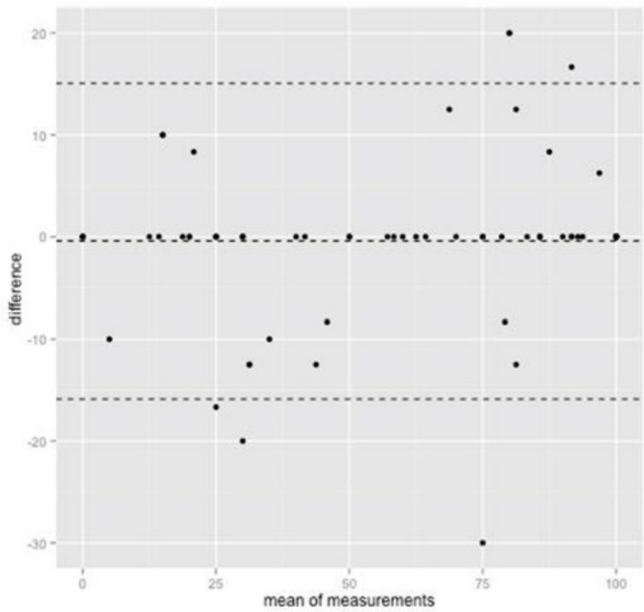


Figure 5.2 Bland Altman plot for the agreement in the ratings with the TPS method.

Every point represents a data point, each assessed by the two measurements. The abscissa displays the mean of the two measurements. The ordinate displays the difference between the two measurements. The dotted line in the middle represents the absolute mean of the differences. The outer two dotted lines represent the mean plus/minus 1.96 times the standard deviation of the difference.

Table 5.4 Pearson correlation for all groups of raters

	TPS 1	TPS 2	CEM 1
TPS 1			
TPS 2	.97***		
CEM 1	.82***	.79***	
CEM 2	.79***	.76***	.85***

*** *p*<.001.

Concurrent validity of the CEM and the TPS

To examine whether both assessment methods resulted in similar ratings, Pearson correlations were computed between the TPS-ratings and the CEM-ratings (see Table 5.4). All correlations were significant and higher than .75.

Discussion

The aim of this study was to explore the reliability and validity of the newly developed Core Elements Method (CEM) to asses task performance in patients with dementia. Therefore CEM was compared with the Task Performance Scale (TPS), a rating method that was applied in previous studies examining task performance in patients with AD and brain injury (Bertens et al., 2013; Dechamps et al., 2011). The interrater reliabilities of CEM and TPS and their concurrent validity were analysed.

The interrater reliabilities as reflected by the ICC values for both methods were excellent, although the confidence limits were wide, indicating that the sample mean could be vary considerably around the true mean. However, additional Bland-Altman plots showed no significant differences in absolute scores given between the TPS raters and between the CEM raters indicating that raters agreed in their ratings within each method. The results showed high and significant correlations between both methods, strongly suggesting that the CEM ratings and TPS ratings are highly related to each other and that both methods are measuring the same construct. Furthermore, CEM and TPS raters used almost the full assessment range to evaluate the videos.

In line with these findings Farina and colleagues (2010) also found a high interrater and a sufficient test-retest reliability for their Functional Living Scale Assessment (FLSA) to asses IADL performance in patients with AD based on the degree of assistance needed to complete a task. Limitations of this study were that they used several standardized IADL tasks with standardized tools. Another disadvantage is that ratings by a trainer or rater are laborious and not always completely objective. Therefore Event Monitoring System (EMS) has gained interest as a measure of task performance using a computer based system.

Although EMS is very promising and seems to be more objective than the FLSA, it can be used only for standardized tasks and in a standardized setting.

In conclusion, we suggest that CEM and TPS are more preferable than the above mentioned assessment methods, since they can be used in natural settings and are flexible enough for examining individual performances of/and personalized tasks without compromising in agreement between raters. Furthermore, CEM and TPS also take the quality of the performance into account. There are several differences between CEM and TPS relevant to point out. First, the TPS method was performed by two experienced neuropsychologists. This is in contrast with the CEM method that was performed by psychology novices who were not specifically familiar with dementia patients or EL and therefore received one hour of training. For TPS, scripts for each activity were made and consensus about these scripts was reached before the actual rating. This contrasts with the CEM method where the raters received a catalogue with detailed task description and additional notes of the therapist beforehand. The TPS ratings were done over a short amount of time, where CEM ratings were made immediately after an evaluation measurement. Thus, with less skilled raters and no need for discussion to reach consensus about the task description (as in TPS) CEM succeeds to rate similarly as TPS. Furthermore, the core elements could also be used as building blocks to teach tasks and thereby supporting the therapists in their treatment adherence, although this latter has not been examined yet.

Limitations

A limitation of the present study is that raters exclusively applied either CEM or TPS. In future research a cross-over design is recommended in which the two methods are used by both groups of raters. In addition, comparisons of CEM and TPS ratings at different time points are required in order to determine the sensitivity to change of both methods. One could argue that it is a limitation that TPS and CEM were only studied in the EL group and not in the TEL group. Since the rating procedure is the same in both learning conditions (EL vs. TEL), it is not expected that ratings in the TEL condition will lead to different results.

Conclusion

To our knowledge, this is the first study that evaluates assessment methods to rate everyday task performance in patients with dementia who were taught IADL with EL in clinical research. CEM is recommended for assessing everyday task performance in clinical trials, because this method demonstrated sufficient variance, excellent interrater reliability and high correlations with TPS, which is more complex and time-consuming to use in clinical trials. Furthermore core elements can be used to support therapists during training sessions as they serve as building blocks to teach tasks in a structured manner.

6 Structured relearning of activities of daily living in dementia – the randomized controlled REDALI-DEM trial on errorless learning

Published as:

Voigt-Radloff, S.,*de Werd, M. M. E.,* Leonhart, R., Boelen, D. H. E.,Olde Rikkert, M. G. M., Fliessbach, K., Klöppel, S., Heimbach, B., Fellgiebel, A., Dodel, R., Eschweiler, G. W., Hausner, L., Frölich, L., Kessels, R. P. C., & Hüll, (2017) M. Structured relearning of activities of daily living in dementia: The randomized controlled REDALI-DEM trial on errorless learning. *Alzheimer's Research & Therapy,* 9(1), 22.

* shared first authorship

Abstract

Introduction Errorless learning (EL) is a method for optimizing learning, which uses feed-forward instructions in order to prevent people from making mistakes during the learning process. The majority of previous studies on EL taught patients with dementia artificial tasks with little or no relevance for their daily lives. Furthermore, only a few controlled studies on EL have been performed so far and just a handful of studies have examined the long-term effects of EL. Tasks were not always trained in the patients' natural or home environment, limiting the external validity of these studies. This multi-center parallel randomized controlled trial examines the effects of EL compared to trial and error learning (TEL) on the performance of activities of daily living in persons with Alzheimer's or mixed-type dementia living at home.

Methods Patients received 9 one-hour task training sessions over 8 weeks using EL or TEL. Task performance was measured using video observations at week 16. Secondary outcome measures were task performance measured at week 26, satisfaction with treatment, need for assistance, challenging behavior, adverse events, resource utilization and treatment costs.

Results 161 participants were randomized, of whom 71 completed the EL and 74 the TEL arm at week 11. Sixty-nine EL patients and 71 TEL patients were assessed at the 16-week follow-up (the primary measurement endpoint). Intention to treat analysis showed a significantly improved task performance in both groups. No significant differences between the treatment groups were found on primary or secondary outcomes.

Conclusions Structured relearning improved the performance of ADLs. Improvements were maintained for 6 months. EL had no additional effect over TEL.

Introduction

The increasing deterioration of cognitive and daily functioning in Alzheimer's dementia (AD) causes the main burden for patients, their caregivers and society, while options for disease-modifying treatments are still lacking (Ballard et al., 2011; Winblad et al., 2016). Evidence from systematic reviews of small-scale clinical trials suggests that structured teaching techniques may optimize or even stabilize daily functioning in AD (Clare & Jones, 2008; Kessels & de Haan, 2003; de Werd et al., 2013b). Errorless learning (EL) is a prominent method for optimizing learning, which uses feed-forward instructions in order to prevent people from making mistakes during the learning process. It is assumed that by preventing errors during learning, the limited cognitive capacity of AD patients is directed towards the acquisition of the correct steps of a task, without interference of occurring errors (Clare & Jones, 2008). The rationale behind EL is that explicit memory is responsible for recognizing and correcting the errors that are made during learning. In people with AD who have profound deficits in explicit memory, these errors may not be recognized as such and are therefore not corrected, but instead implicitly consolidated into long-term memory. EL may include different techniques such as graded tasks broken down into small steps, modeling, encouragement not to guess, anticipating errors and immediate correction, prompts when steps are successfully performed, vanishing cues and spaced retrieval (rehearsal of the retrieval of information using increasing time intervals; Clare & Jones, 2008; de Werd et al., 2013b).

A meta-analysis on the treatment effects of EL and the method of vanishing cues in amnesic patients (N=192) showed a large and beneficial effect for the EL treatment compared to trial-and-error learning (TEL; Kessels & de Haan, 2003). A qualitative review (de Werd et al., 2013b) included 26 studies on teaching persons with dementia daily tasks or skills. Five controlled group studies and 12 single-case studies obtained significantly superior effects of EL immediately after training compared with TEL or a no-treatment condition. Seventeen studies showed maintenance of EL effects at follow-up. Clare and Jones (2008) performed a critical review including 15 empirical studies using group designs to compare the efficacy of EL and errorful learning in persons with brain injury or dementia. These authors argued that EL may be particularly beneficial in individuals with severe memory impairments. They concluded that benefits of EL for persons with early-stage and moderate dementia are mixed, with some studies finding an EL benefit and others reporting no additional advantage of EL.

The majority of previous studies taught dementia patients artificial tasks with little or no relevance for patients in daily life. Furthermore, only a few controlled studies on EL have been performed so far and just a handful of studies have examined the long-term effects of EL. Moreover, large differences were found across studies in the types of tasks that were taught and the exact errorless teaching methods that were used. Tasks were not always trained in the patients' natural or home environment, limiting the external validity of these studies. Therefore, we conducted the REDALI-DEM trial (RElearning methods on DAily LIving task performance of persons with DEMentia), a multi-site randomized controlled trial (RCT) with the aim to compare the effects of EL vs. TEL on the performance of activities of daily living in persons with mild to moderate dementia living at home. Based on earlier studies (Clare & Jones, 2008; de Werd et al., 2013b) we hypothesised that EL is superior compared to TEL .

Secondary questions of interest were: (a) Can effects on performance be maintained for six months? (b) Does relearning of daily living tasks show transfer effects to the patients' initiative or need for assistance in activities of daily living? (c) What are the treatment costs? (d) How is the treatment accepted by patients? (e) What adverse events do occur during the treatment period?

Methods

Design

We used a six-center single-blind, active-controlled design with a 1:1 randomization for two parallel groups to compare the effects of EL and TEL. The study was registered in the German Register of Clinical Trials (DRKS00003117), which is connected to the International Clinical Trials Registry Platform. The a priori published study protocol is available elsewhere (Voigt-Radloff et al., 2011). Prior to the RCT, a pilot study was performed in which the study procedure including the EL and TEL interventions were evaluated and monitored. The practical issues and difficulties that the therapists encountered were discussed, leading to minor protocol amendments after the six-month trial pilot phase and before start of recruitment concerned the participating study sites (two resigned due to organizational reasons, and to safeguard sufficient power a new one was included), inclusion criteria (the threshold for the need for assistance in activities of daily living was increased), intervention procedures (time to select training activities was extended from one to three sessions; the number of refresher sessions was reduced from three to two; special cue card series were not used in the EL arm) and outcome measurement (the task performance scale: TPS, was specified).

Previously available outcome measures to assess task performance have not been investigated with respect to reliability and construct validity in naturalistic settings using daily-life tasks. This pilot phase was therefore also used to validate the newly developed outcome measure: the Core Elements Method (CEM). The interrater reliability and concurrent validity of CEM and TPS were analyzed and compared (de Werd et al., 2016). Based on these results, TPS and CEM were found to be equally valid for the assessment of task performance in people with dementia. However, CEM was found to be less complex and less time-consuming compared to TPS, and therefore used in the current RCT.

Participants and setting

Persons living at home and diagnosed with mild to moderate AD or mixed-type dementia (Mini Mental State Examination; MMSE, (Folstein et al., 1975) scores between 14 and 24) were eligible. Informed consents of patient and primary caregiver were required. A caregiver had to be available for rating the need for assistance in activities of daily living. For inclusion, the mean score of the five household items in the performance scale of the Interview for Deterioration in Daily Living Activities in Dementia (IDDD; Teunisse & Derix, 1997) had to be 2.5 or higher.

Exclusion criteria were major depression (Geriatric Depression Scale – Short Form; GDS-15 ≥ 9; Sheikh & Yesavage, 1986), major need of physical nursing care (≥ 120 min per day) as well as severe behavioral disturbances, unstable medical conditions or lack of attention and understanding of instructions in German as judged by the recruiting study physician and involvement in other clinical trials.

The REDALI-DEM study sites were six outpatient memory centers at university hospitals; they are located throughout Germany in urban regions with catchment areas of about 100,000 (Marburg and Tübingen) 300,000 (Freiburg and Mainz) and 400,000 (Bonn und Mannheim) inhabitants and all centers have provided outpatient dementia care for five to 17 years. The standard service of the study sites comprised a diagnostic work-up for dementia and related diagnoses as well as recommendations of risk reduction, dementia medication and non-pharmacological treatments. Principal investigators of the centers were psychiatrists, neurologists or geriatricians with long-standing experience in dementia care.

Procedures

After patient recruitment, the site investigator requested for randomization via email. Within 48 hours, the trial statistician at a detached site provided a 1:1 randomization (computer-generated, block sizes varying at random, no stratification) for each individual case. Independent assessors were blinded to group assignment. Blinded assessment of the treatment effects was ensured by videotaping the task performance and removing all hints of the treatment modality. Experimental and control interventions included the same amount of personal involvement. Neither patients nor therapists were presented an assumption as to which intervention may be more likely to improve activities of daily living. At week 0, trial physicians completed the baseline assessment (t_0) at the study center and patients were randomized. At weeks 1 and 2, the therapists selected two tasks that were relevant for the patient in daily life, but which he/she was no longer able to perform independently together with the patients and his or her caregiver. Then the baseline task performance was videotaped. From weeks 3 to 10, patients received nine one-hour training sessions at home. Task performance was videotaped again at weeks 11 (t_1), 16 (t_2, the primary outcome measure) and 26 (t_3). Therapists carried out two one-hour refresher-trainings in weeks 19 and 20. Trial physicians completed the follow up

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assessments at the study center at weeks 16 and 26 (see Table 6.1 for the intervention scheme).

Table 6.1 Intervention scheme

Weeks	**0-2**	**3-10**	**11**	**16***	**19-20**	**26**
Measurement	T_0		t_1	t_2		t_3
Intervention		9 sessions	break		2 refresher sessions	

* Primary outcome measure

Interventions

Two separate treatment manuals for errorless (EL) or trial and error learning (TEL) have been developed, pilot-tested, adapted and taught in introductory seminars. Per study site, we trained at least three therapists (occupational therapist, nurse, psychologist or social worker). To minimize contamination, we separated the main therapists for EL from the main therapists for TEL while teaching the experimental and control treatment protocol. The third therapist received both trainings, serving as a substitute; this person was not allowed to carry out more than four sessions per patient. To reduce selection bias, we assigned interventionists to EL, TEL or substitute at random.

By shared decision making, the therapist and the patient selected two training tasks relevant for the patient's daily living. The two selected tasks were referred to as task A and task B respectively (note that these two tasks thus were different for each patient). To do so, they used a catalogue of 43 pre-defined tasks (20 household tasks such as doing the dishes or laying a table, 11 leisure tasks such as performing light physical exercise or taking photos, 12 cognitively challenging tasks such as finding a bus connection or surfing the internet). Tasks had to be independent from changing seasons or environments (e.g., not shoveling snow, not using equipment that will be renewed soon) and repeatable within 30 min (e.g., not preparing an extensive meal). Within the first three one-hour sessions the tasks had to be selected and checked for relevance and the patient's performance level had to show room for improvement (50 to 75 % insufficient performance).

Each therapist's session consisted of one hour for the actual training (30 min each for task A and B) and one hour for documentation and travel time. If patients expressed concerns, therapists could reduce the training time to engage in motivating conversation. For the training, the existing home equipment and no extra materials were used. Caregivers were not present during training.

Errorless learning (experimental arm)

The therapist divided the task into appropriate steps, demonstrated and explained the first step, asked the patient to perform the first step and accompanied the patient's step performance by continuous verbal instruction. As soon as the therapist anticipated a potential error, he/she intervened by giving a short demonstration of the correct performance. When the patient had performed the first step correctly, the therapist demonstrated and instructed the next step. These procedures of instruction, performance and early intervening to avoid errors were followed until the whole task was performed. The training stopped after 30 min, irrespective of how often the task or individual steps were performed. After the fifth session, the therapist was allowed to reduce the amount of modeling and verbal instruction, but had to provide it again as soon as the patient showed potential errors, hesitated or showed uncertainty in performing the task (Table 6.2).

Table 6.2 Overview of the errorless learning (EL) and trial and error learning (TEL) arms of the intervention

EL intervention	TEL intervention
- Task is divided into core elements - Each step is demonstrated by the therapists accompanied with verbal instructions - The patient is then invited to perform the task step, and is verbally guided by the therapists - Only, when the patient performed the first step correctly, the therapist demonstrates and instructs the next step - In case of hesitation, or (near) error by the patient, the step is repeated again and the sequence is also repeated again (both with demonstrating and verbal instructions by the therapist). - From sessions six onwards it is allowed to fade out help.	- The patient must try to perform the task by him/herself for the first 10 minutes, regardless of the amount of errors or hesitations. - It is only allowed to intervene within the first 10 minutes when the patient becomes irritated or frustrated. - After 10 minutes it is allowed to intervene, using a stepwise approach: 1. Stimulating the patient by asking open questions. 2. Summarizing what has already been done and what the task goal is. 3. Giving clear verbal instruction 4. Demonstrating the task steps.

Trial and error learning (control arm)

The therapist asked the patient to perform the task and did not provide any instruction or demonstration. When the patient made an error, he/she was allowed to guess to self-correct. In the first 10-min period of the training, the therapist did not provide any support, apart from observing with interest and intervening if the patient showed signs of irritation or frustration. In the second training phase, the therapist used open-ended questions about the purpose of the task after three insufficient trials to find solutions. If the patient still was unable to perform the step, the therapist gave verbal instructions, but did not demonstrate the step. This procedure of the patient performing and guessing, the therapist's supporting open-ended questions and – if necessary – correct instructions were continued until the whole task was performed or the training stopped after 30 min (Table 6.2).

Intervention adherence

Masked external raters assessed the intervention adherence by rating videos of two treatment sessions, one at the beginning and one at the end of the treatment series, for two patients of each therapist. In addition, therapists commented and self-rated their therapeutic interaction, dealing with errors and protocol adherence for each patient after a treatment series was completed in week 11. External and self-ratings were scored on the same 6-point scale with '1' reflecting an excellent job and '6' a poor treatment.

Outcome measures

Task performance was defined as the primary patient-related outcome measure and assessed using the Core Elements Method. All tasks of the catalogue were subdivided into core elements and illustrated with detailed descriptions (see Table 6.3 for an example of an activity, its core elements and the individual steps). Therapists adapted this description to the individual context in the patent's home and specified the required steps to successfully perform each core element of each chosen task. The blinded assessors used these descriptions to rate the patient's actual performance of each core element using a 7-point scale for each task (1 = *not performed at all as trained by the therapist*; 7 = *performed exactly as trained by the therapist;* de Werd et al., 2016).

Secondary outcomes were daily functioning as measured with the IDDD (Voigt-Radloff et al., 2012), resource utilization (Resource Utilization in Dementia; RUD; Neubauer, Holle, Menn, & Grassel, 2009; Wimo & Nordberg, 2007) and satisfaction with treatment measured with a verbal rating scale ranging from 1 (very satisfied) to 5 (very unsatisfied). Furthermore, we assessed several control measures, that is, cognitive status (MMSE; Folstein et al., 1975), dementia stage (Reisberg Clinical Dementia Rating), challenging behavior assessed by the Neuropsychiatric Inventory (NPI; Cummings, 1997; Cummings, Herrschaft, Hoerr, & Tribanek, 2013) and treatment costs using a cost unit rate of €60 per treatment hour including all costs (personnel, material, travel, overhead). In case of group differences, these control measures can be used to adjust for potentional confounding. Death, nursing home admissions and non-elective hospital admissions were defined as serious adverse events.

Statistical analyses

A sample size of 80 participants per treatment arm was calculated for the detection of small effect sizes (f = 0.10) in an analysis of variance with two groups and two repeated measurements at baseline and week 16 hypothesizing an alpha of 0.05, a power of 0.8 and

Table 6.3 Example of an activity divided into different core elements

Activity	**Making a phone call**			
Core element	***Get the number***	***Dial the number***	***Make conversation and end call***	***End task***
Possible steps	- Take a phone book or mobile phone - Search the telephone number in the mobile phone or phonebook - Write the number on a piece of paper	- Press the correct numbers on the telephone to dial the number OR - Select the correct name in the telephone book of the telephone - Press the correct button to make the telephone call	- Talk into the telephone OR - Talk into the phone by using the 'speaker' function - End the call by pressing the correct button	- Place the telephone back in the right position - Put away the telephone book and piece of paper

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a correlation of 0.6 between the measurement points (total n=160). Overall efficacy of treatment was assessed by conducting multivariate analysis of covariance (ANCOVA) controlling for pre-treatment scores on all outcome measures and considering all standards for the testing of assumptions. The multivariate analyses were done separately for primary and secondary outcomes, because of the different numbers of measurement points. For the primary outcome, we performed an intention to treat (ITT) analysis on all randomized patients not dropped out at week 16. We used 10 multiple imputations with the Full Information Maximum Likelihood method when data were missing in single items or scales at week 16 or week 26 and for complete dropouts at week 26. The missing-data mechanism is ignorable if data are missing at random (Enders, 2010). Missing data can be considered Missing Completely At Random (MCAR) if the probability that data are missing does not depend on observed or unobserved data. We used Little's MCAR test to examine whether our missing pattern was completely at random. The control measures cognitive status (MMSE; Folstein et al., 1975), dementia stage (Reisberg Clinical Dementia Rating) and challenging behavior (NPI; Cummings, 1997; Cummings, Herrschaft, Hoerr, & Tribanek, 2013) were analyzed for group differences at baseline and after the intervention. We used SPSS 23.0 and a two-tailed alpha of 0.05 for all statistical analysis.

Results

Recruitment, patient flow and baseline characteristics

The recruitment period lasted 3.5 years from April 2012 to September 2015. Two initial study sites received introduction and training but could not recruit patients, one site due to lack of access to eligible patients, one site because one trained therapist decided to withdraw. Thereafter, a new study site (Mannheim) was recruited and enrolled the first patient in May 2013.

From 161 randomized participants, 140 and 137 respectively received a follow-up assessment at week 16 and week 26 (attrition rate 13.0 % and 14.9 %, Figure 6.1). Reasons for dropout were death (1 EL; 1 TEL), non-elective admission to hospital (1 EL; 2 TEL), admission to nursing home (2 EL; 2 TEL) and withdrawal (9 EL; 6 TEL). Group differences in the baseline characteristics of patients, caregivers and therapists were clinically not relevant (Table 6.4 and Appendix D).

Intervention delivery and adherence

From the 81 randomized patients in the EL group, all sessions completed in full in 71 persons. In 5 cases, not all but a sufficient number of sessions (≥ 9) was completed. In another 5 cases, an insufficient number of sessions (3; 4; 5; 5 or 6 sessions) had taken place. From the 80 cases randomized to TEL, the intervention was fully completed in 74 cases and sufficiently completed in 2 cases (≥ 9 sessions). Four cases received an insufficient treatment (3; 4; 5 or 6 sessions). No patient changed from EL to TEL condition or from TEL to EL condition.

Tasks that were trained the most included following written instructions to perform light exercises (23 EL / 27 TEL), making a phone call (15/17), selecting a specific TV broadcast (11/16), writing a shopping list (9/15), finding a telephone number (6/16), playing a DVD (11/1), playing a CD at a convenient volume (9/2) and coloring an outlined picture (5/5).

After the last treatment session, therapists rated themselves on three items (therapeutic interaction, dealing with errors, and manual adherence). Each of these items was scored on a 6-point scale (1= excellent, 2= good, 3= adequate, 4= sufficient, 5= insufficient, 6=poor). On average, therapists in both groups, self-rated their intervention adherence as 'good' (EL: mean 1.8, SD 0.4; TEL: mean 2.0, SD 0.5). External raters used the same three items and same 6-point scale to rate the therapists' adherence, rating them on average as 'good to excellent' (EL: mean 1.5, SD 0.8); TEL: mean 1.6, SD 0.8). After study completion we asked therapists for their assumptions about the superior learning technique. Six out of eight EL therapists (3 missing data) and three out of ten TEL therapists rated the technique they had performed as superior.

Outcomes

Primary outcome: ITT-analysis of the 140 participants with a week-16 follow-up assessment showed significantly improved task performance of the self-selected task A and task B in both groups from baseline to week 16 (standardized effect size [95% CI]: 0.61 [0.37 – 0.85] task A; 0.47 [0.23 – 0.71] task B) and to week 26 (0.41 [0.17 – 0.64] task A; 0.26 [0.03 – 0.50] task B). No significant time by treatment group interaction was found and no differences were found between task A and B (figure 6.2 and table 6.5). The assumptions for a multiple imputation were fulfilled as the Missing Completely At Random Test (Little's MCAR test) showed a missing pattern completely at random (χ^2= 102.4, df = 102, p = .471).

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Assessed for eligibility (N =216)

Excluded (n=55)
- 1 MMSE > 24 (cognition too good)
- 1 MMSE < 14 (cognition too bad)
- 6 IDDD -B < 2.5 (daily functioning too good)
- 1 too high need for physical nursing care
- 2 admitted to hospital before baseline completed
- 24 withdrew consent before baseline completed
- 16 did not select training activities: 7 not disabled, 3 too disabled, 6 without reason
- 4 excluded for organisational reasons: 1 long distance to patient's home, 1 therapist ill and deputy not available, 2 without reason

Randomisation and baseline assessment completed (N = 161)

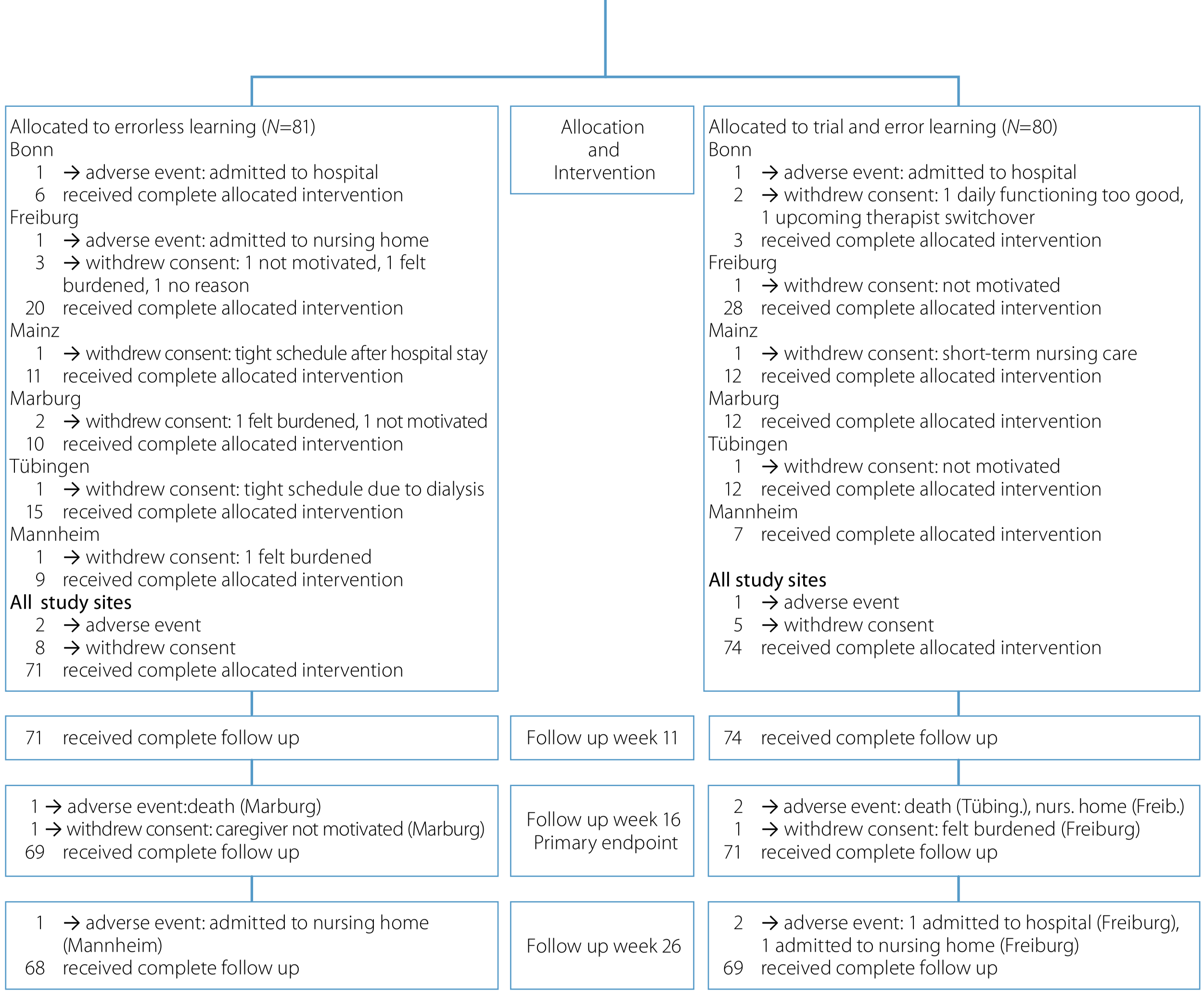


Figure 6.1 Flow of participants through the trial

Table 6.4 Example of an activity divided into different core elements

	Errorless learning			Trial and error learning		
	Completers week 16 (*N*=69)	Dropouts week 16 (*N*=12)	Total (*N*=81)	Completers week 16 (*N*=71)	Dropouts week 16 (*N*=9)	Total (*N*=80)
Patient – demographic characteristics						
Age, years (SD)	76.7 (8.0)	79.3 (6.1)	77.1 (7.8)	76.2 (6.5)	75.2 (9.4)	76.1 (6.8)
Sex, female (%)	40 (58)	6 (50)	46 (57)	40 (56)	6 (67)	46 (58)
School						
no school graduation (%)	2 (2.9)	0 (0.0)	2 (2.5)	1 (1.4)	0 (0.0)	1 (1.3)
middle school graduation [9 or 10 years] (%)	60 (87.0)	11 (91.7)	71 (87.7)	52 (73.2)	7 (77.8)	59 (73.8)
high school graduation [12 or 13 years] (%)	7 (10.1)	1 (8.3)	8 (9.9)	18 (25.4)	2 (22.2)	20 (25.0)
Vocational education						
Not completed (%)	17 (24.6)	2 (16.7)	19 (23.5)	12 (16.9)	3 (33.3)	15 (18.8)
Completed (%)	52 (75.4)	10 (83.3)	62 (76.5)	59 (83.1)	6 (66.7)	65 (81.3)
Patient – clinical characteristics						
TMT number of missing data	2	-	2	3	-	3
TMT number of not completed [> 240 sec]	19	2	21	12	1	13
TMT number of completed [≤ 240 sec]	48	10	58	56	8	64
TMT completed, seconds (SD)	92.6 (40.9)	122.6 (61.6)	97.8 (45.9)	106.0 (50.8)	106.8 (45.3)	106.1 (49.8)
MMSE (SD)	19.8 (3.3)	19.1 (3.0)	19.7 (3.2)	19.7 (3.3)	20.3 (3.6)	19.8 (3.3)
Reisberg (SD)	4.3 (0.6)	4.3 (0.5)	4.3 (0.7)	4.3 (0.7)	4.3 (0.7)	4.3 (0.7)
GDS (SD)	2.7 (1.7)	2.8 (1.9)	2.7 (1.9)	2.8 (2.2)	2.6 (2.1)	2.8 (2.2)
Years since dementia onset, years (SD)	2.2 (2.3)	1.8 (1.3)	2.1 (2.1)	1.5 (1.5)	3.3 (4.3)	1.7 (2.1)
Number of patients without additional diagnosis (%)	27 (39.1)	4 (33.3)	31 (38.3)	30 (42.3)	4 (44.4)	34 (42.5)

Number of patients with 1 to 3 additional diagnoses (%)	33 (47.8)	6 (50.0)	39 (48.1)	33 (46.5	4 (44.4)	37 46.3)
Number of patients with 4 or more additional diagnoses (%)	9 (13.0)	2 (16.7)	11 (13.6)	8 (11.3)	1 (11.1)	9 (11.3)
Primary caregiver						
Age, years (SD)	62.3 (13.5)	65.4 (12.9)	62.7 (13.4)	62.9 (13.8)	60.2 (12.5)	62.6 (13.6)
Sex, female (%)	25 (36.2)	4 (33.3)	29 (35.8)	26 (36.6)	3 (33.3)	29 (36.3)
Relation						
Spouse (%)	35 (50.7)	7 (58.3)	42 (51.9)	41 (57.7)	4 (44.4)	45 (56.3)
(Grand-)Children (%)	30 (43.5)	4 (33.3)	34 (42.0)	27 (38.0)	5 (55.6)	32 (40.0)
Others (%)	4 (5.8)	1 (8.3)	5 (6.2)	3 (4.2)	0 (0.0)	3 (3.8)
Living together (%)	47 (68.1)	9 (75.0)	56 (69.1)	47 (66.2)	5 (55.6)	52 (65.0)
Caring for the patient: months (SD)	26.4 (26.8)	33.1 (34.9)	27.4 (28.0)	21.9 (18.7)	33.4 (37.2)	23.2 (21.5)

* *N*, Number of cases, SD, Standard Deviation; %, percentage; TMT, Trial Making test; MMSE, Mini Mental State Examination; GDS, Geriatric Depressions Scale.

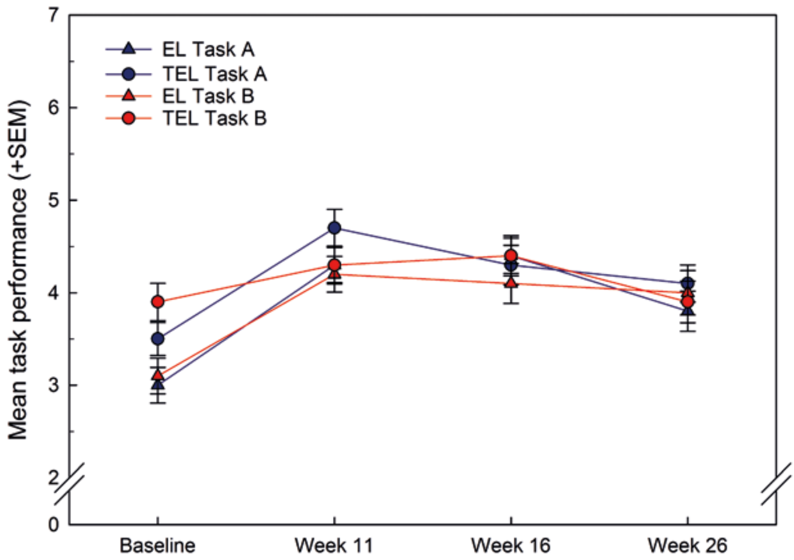


Figure 6.2 Task performance ratings for the errorless (EL) and trial-and-error (TEL) conditions for the two trained tasks (A and B) at baseline and weeks 11, 16 and 26

Secondary outcome and control measures: Patient's need for assistance (measured with the IDDD), cognition (measured with the MMSE), challenging behavior (measured with the NPIQ) and the Satisfaction with Treatment verbal rating scale, as well as treatment costs and resource utilization (measured with the RUD) kept stable over 26 weeks and did not significantly differ by treatment group or measurement time point (Table 6.5). Patients of both groups rated satisfaction with treatment as very good. Costs were similar for EL and for TEL, €1,907 and €1,897, respectively (see Appendix E). As we found no group differences at baseline or after the intervention on any of the control measures (Table 6.5), we did not use them for adjusting the primary outcome for confounding.

Study sites reported 4 serious adverse events in the EL group (1 death, 1 non-elective hospital admission, 2 nursing home admissions) and 5 in the TEL group (1 / 2 / 2 respectively). Study site leaders judged all serious adverse events as unrelated to the study treatment or assessment.

Discussion

This is the first large RCT on EL as a method to teach persons with dementia activities of daily living in their own environment. The objective of this multi-center REDALI-DEM trial was to evaluate whether EL or TEL demonstrates superior effects on the performance of two relevant activities of daily living in persons with mild to moderate AD living at home. Results showed an improved post-treatment performance of daily living tasks in both arms, but EL was not found to be superior to TEL. The relearning of activities did not affect the patients' initiative or need for assistance in activities of daily living. Both EL and TEL were very well accepted by the patients and the costs did not differ between both treatments. Although serious adverse events occurred, these were judged unrelated to the intervention. The fact that improved task performance in both treatment arms did not lead to improvement on secondary outcomes indicates that no generalization effects on daily life functioning were found, but only improvements on the trained tasks. Note that the lack of to be expected generalization effects has been put forward as a limitation of errorless learning previously (Clare & Jones, 2008).

These results are not in agreement with most earlier findings on the effects of EL, since previous reviews on EL suggested superior results of EL compared to TEL. However, most previous studies were small-scale trials or proof-of-principle studies in which patients were taught artificial tasks that had marginal relevance to them (such as learning an artificial word list). Our hypothesis that EL would be a more effective teaching method for persons with dementia was based on these earlier findings. However, this hypothesis is not confirmed in this first adequately powered, rigorously designed and well performed multi-center RCT.

Recent studies that have used procedural tasks or skills to examine the effects of EL in patients with dementia showed mixed results (Bourgeois et al., 2016; de Werd et al., 2013b). One explanation for these mixed findings may lie in the nature of the tasks. That is, there is some evidence that EL works through the facilitation of implicit, automatic learning processes, which have been shown to be intact in patients with dementia (van Halteren-van Tilborg et al., 2007). Possibly, the procedural nature of the tasks that were trained in the current RCT may in itself have already facilitation learning, irrespective of the error reduction aspect. Indeed, learning has taken place in both treatment arms, which is in line with this view. Moreover, both treatment procedures could be categorized as forms of 'structured learning'. That is, therapists adopted a step-by-step approach, provided feedback and stimulated engagement in the task. This structuring may have optimized learning in itself, resulting in better post-treatment task performance, an effect that was also maintained at the follow up assessment. In addition, to measure our primary outcome a recently developed rating scale was used: the Core Elements Method (CEM). Although result from our previous pilot phase showed excellent validly and reliability, the current results have to be interpreted with some caution, since its psychometric properties have only been examined in one study.

Table 6.5 Patient-related outcomes following structured relearning of individually daily living tasks (ITT-analysis of 140 participants with follow up data at week 16 and multiple imputations when data were missing in single measurement instruments)

	Sample errorless	Sample trial & error	Baseline errorless	Baseline trial & error	Week 11 errorless
	N	N	mean (SD)	mean (SD)	mean (SD)
Primary patient-related outcome					
Task performance rating video A (SD), 1=worst, 7=best	69	71	3.0 (1.6)	3.5 (1.5)	4.3 (1.7)
Task performance rating video B (SD), 1=worst, 7=best	69	71	3.1 (1.6)	3.9 (1.7)	4.7 (1.6)
Secondary patient-related outcomes					
IDDD A initiative (SD), 0=worst, 36=best	69	71	18.4 (6.6)	18.2 (5.8)	
IDDD B performance (SD), 44=worst, 0=best	69	71	21.3 (6.0)	21.4 (7.2)	
Treatment satisfaction (SD), 5=worst, 1=best	69	71			1.5 (0.6)
Control measures					
MMSE (SD), 0=worst, 30=best	69	71	19.8 (3.3)	19.7 (3.3)	
Reisberg (SD), 1=worst, 7=best	69	71	4.3 (0.6)	4.3 (0.7)	
NPIQ (SD), 36=worst, 0=best	69	71	7.2 (4.0)	7.5 (5.2)	

Abbreviations: SD, Standard Deviation; IDDD, Interview for Deterioration in Daily Living Activities; MMSE, Mini Mental State Examination; NPIQ, Neuropsychiatric Inventory Questionnaire

This pilot phase was therefore also used to validate the newly developed outcome measure: the Core Elements Method (CEM). The interrater reliability and concurrent validity of CEM and TPS were analyzed and compared (de Werd et al., 2016). Based on these results, TPS and CEM were found to be equally valid for the assessment of task performance in people with dementia. However, CEM was found to be less complex and less time-consuming compared to TPS, and therefore used in the current RCT.

Strengths of the current study include the naturalistic setting of the intervention. That is, the intervention was carried out in the patients' own homes, using tasks that were relevant for them to acquire. Patients also appreciated the intervention very much. This may have also promoted learning in both arms, obscuring a potential superior effect of error reduction. In addition, the large sample size and low drop-out rate can be considered strengths of the study. The low drop-out rate prevented for attrition bias and justifies that

Week 11 trial & error	**Week 11 group Δ**	**Week 16 errorless**	**Week 16 trial & error**	**Week 16 group Δ**	**Week 26 errorless**	**Week 26 trial & error**	**Week 26 group Δ**
mean (SD)	mean [95%-CI]	mean (SD)	mean (SD)	mean [95%-CI]	mean (SD)	mean (SD)	mean [95%-CI]
4.2 (1.7)	-0.1 [0.6,0.5]	4.4 (1.8)	4.1 (1.8)	0.3 [0.3,0.9]	3.8 (1.8)	4.0 (1.7)	0.3 [-0.5,0.8]
4.3 (1.6)	-0.4 [0.9,0.1]	4.3 (1.8)	4.4 (1.6)	-0.1 [0.5,0.7]	4.1 (2.0)	3.9 (1.9)	-0.2 [0.9,0.5]
		17.7 (7.0)	16.8 (7.2)	-0.9 [3.3,1.5]	16.2 (7.5)	15.7 (7.4)	-0.4 [3.1,2.0]
		21.0 (8.6)	20.9 (9.0)	0.0 [3.0,2.9]	22.3 (10.2)	23.6 (10.1)	1.4 [2.1,4.8]
1.5 (0.5)	0.0 [0.2,0.2]				1.5 (0.9)	1.4 (0.7)	-0.1 [0.4,0.2]
		19.0 (4.8)	19.6 (4.2)	0.6 [0.9,2.1]	18.2 (5.2)	18.9 (5.1)	0.7 [1.1,2.4]
		4.4 (0.6)	4.4 (0.7)	0.1 [0.2,0.3]	4.4 (0.6)	4.4 (1.0)	0.0 [0.3,0.3]
		7.9 (5.2)	8.1 (5.2)	-0.1 [1.7,1.8]	8.0 (5.4)	8.6 (6.5)	0.6 [1.5,2.7]

we did not include all randomized patients in our ITT analysis, but only those with data at least at two time points (baseline and primary outcome time point at week 16). Data imputation for participants with data of only one time point is prone to adverse events (three patients). Note that all other dropouts withdrew their consent.

All persons involved were blinded for our hypotheses and the raters who assessed the primary outcome were also fully blinded for treatment arms and hypothesis. Treatment adherence of the therapists was monitored using self- and external ratings, showing good treatment adherence. The planned sample size was reached in this RCT and the findings are reported according to the CONSORT guidelines (Schulz, Altman, & Moher, 2010), including long-term results, treatment costs and adverse events.

Limitations include the heterogeneity of the tasks that were trained. Tasks like making a grocery list, or planning a trip may have had more degrees of freedom that straightfor-

6

ward 'stimulus-response' tasks such as dialing a telephone number or playing a DVD. A methodological limitation was that patients and therapists by definition were not blinded for the treatment itself, although measures were taken to prevent cross-over effects by letting therapists only give one type of intervention.

Conclusion and future research

Persons with dementia can still be re-trained in performing activities of daily living using structured learning, with effects being maintained for six months. However, EL had no additional effect over TEL. Future research should examine whether the effectiveness of structured learning depends on patient- or task-specific characteristics.

7 Summary and general discussion

Summary

The objectives of the studies presented in this thesis were 1) to develop and evaluate a manual on errorless learning, 2) to rate the performance of everyday-life tasks and 3) to examine the effectiveness of errorless learning. In this chapter an overview of the main results and conclusions will be summarized, followed by a discussion of the studies' strengths and limitation, as well as their practical implications.

Errorless learning (EL) is an approach based on the idea that memory performance improves if errors are prevented during the acquisition and retrieval of information that is learned. A learning environment is created in which errors are prevented as much as possible. However, at the start of this project, it was unclear how EL should be applied in clinical practice of dementia care. Therefore we started with a qualitative review of the literature on EL of everyday-life tasks in patients with dementia (**Chapter 2)**. The results of our review of 26 studies applying principles of EL showed that people with mild to moderate dementia can (re)learn meaningful everyday-life tasks or relevant knowledge using an error-reducing teaching approach. Five controlled group studies and 12 single-case studies obtained significantly superior effects using EL, compared to an errorful, or Trial and Error Learning (TEL). Notably, a considerable number of these studies included follow-up assessments showing that these beneficial effects were maintained over time, even weeks or months after the training had ended. Based on these findings, EL appears to be a promising principle for teaching people with dementia relevant everyday-life tasks. Furthermore, this review provided important information on how to apply EL in dementia care. Studies suggest that procedural tasks should be trained using a stepwise approach, with the therapist modeling each step and providing verbal cues to guide the patient. Providing verbal instructions, spaced retrieval (rehearsal of the retrieval of information that is taught with increasing time intervals, which is not an error-reduction principle in itself), and asking patients not to guess are most suitable for the acquisition of nonprocedural tasks. Vanishing cues, that is, fading cues and prompts when steps are successfully performed, are effective in steadily reducing the amount of help needed from the therapist and have been successfully used in a wide variety of tasks, such as making a phone call and route learning. Training intensity and duration should be tailored to the needs of the individual patient and the training should preferably take place in a familiar environment to facilitate transfer. Eventually these recommendations for effective EL based training programs were used to develop a practical EL manual for professionals working in dementia care, as described in **Chapter 3.**

First, we conducted a nationwide survey exploring the interest in and feasibility of EL in dementia care in the Netherlands. Based on the survey results and available evidence in the literature, we subsequently drafted an EL manual. This preliminary manual was evaluated in a Delphi round using the AGREE instrument, which is a validated instrument to assess manuals and protocols. Forty-five health professionals associated with 22 Dutch dementia care facilities, including those survey respondents who had piloted an EL intervention in accordance with the concept manual and an expert panel with eight professionals representing various disciplines, deemed EL to be meaningful and feasible for use in dementia care and their residential facilities. The EL manual was published in the Dutch and the English language and formed the basis of the REDALI-DEM Randomized Controlled Trial (RCT), in which the effectiveness of EL was compared to TEL in teaching people with dementia two everyday-life tasks at their homes.

Chapter 4 describes the REDALI-DEM pilot study in which the treatment adherence of therapists in two treatment arms (EL vs. TEL) was examined. Treatment adherence of the therapists in both learning conditions was monitored using video observations of two treatment sessions and were rated on three items (therapeutic interaction, dealing with errors, and manual adherence) by two raters on a six-point scale. Results showed an excellent consistency between both raters. Therapists improved their performance during either intervention and the overall execution of the intervention was satisfactory for all therapists at the end of the treatment. Treatment adherence did not differ between both interventions. The results of this study were used to optimize study procedures before the start of the large REDALI-DEM RCT. The results in this chapter indicate that it is possible to execute a standardized EL protocol to teach people with dementia everyday-life tasks in their own homes. The protocol proved to be flexible enough to apply in people with mild to- moderate dementia, for a variety of everyday-life tasks.

In **Chapter 5** the validity and reliability of a new assessment procedure to assess task performance was explored; the Core Elements Method (CEM). So far, the effects of EL have mostly been examined by counting the number of correctly executed task steps and/or their quality of performance (i.e., correct sequencing, omissions, etc.). An example of such a rating method is the Task Performance Scale (TPS). In contrast, the CEM rates building blocks (which are series of task steps that are grouped in a logical way) of activities rather than individual steps. Task performance was assessed in 35 patients with Alzheimer's dementia (AD) recruited from the REDALI-DEM study using both TPS and CEM independently. Results showed excellent interrater reliabilities for both rating methods, meaning that raters agreed in their ratings of task performance for both CEM and TPS. Also, both methods showed a high agreement and correlated highly, meaning that they measured task performance equally. Based on these results TPS and CEM are both valid methods for the assessment of task performance in people with dementia. However, CEM is recommended for assessing everyday task performance in clinical trials, because this method is less complex and time-consuming compared to TPS. Furthermore, the core elements of activities can be used to support therapists during training sessions as they serve as building blocks to teach tasks in a structured manner.

Finally, **chapter 6** describes the REDALI-DEM multi-centre RCT, in which the effectiveness of EL compared to TEL was examined, by teaching everyday-life tasks to a large group (*N*= 145) of people with AD or mixed-type dementia at their homes.

At week 0, trial physicians completed the baseline assessment at the study centre and patients were randomized. At weeks 1 and 2, the therapists selected two training tasks together with the patients and videotaped their baseline task performance. From weeks 3 to 10, patients completed nine one-hour training sessions at home. Task performance was videotaped again at weeks 11 and 16. Secondary outcome measures were task performance measured at week 26, satisfaction with treatment, need for assistance, challenging behaviour, adverse events, resource utilization and treatment costs. Seventy-one experimental (EL) and 74 control patients (TEL) completed the allocated intervention. Intention to treat (ITT) analysis showed significant improved task performance at week 16 in both the EL and TEL group. However, EL did not have an additional effect on task performance, or any of the secondary outcome measures, compared to TEL. Thus, while structured relearning improved the performance of everyday-life tasks, improvements maintained for 6 months, EL had no additional effects over TEL.

General discussion

Development and evaluation of the errorless learning manual

Our literature review extended the existing reviews on EL in people with dementia, by investigating everyday-life tasks performed at people's homes, instead of focusing on artificial tasks examined in controlled or laboratory settings (Clare & Jones, 2008; Middleton & Schwartz, 2012). This review provided important information about practical implications.

Our review and earlier reviews (Clare & Jones, 2008; Middleton & Schwartz, 2012) formed the basis for the development of a preliminary EL manual. A strength of this approach was that this preliminary manual was evaluated by professionals working in dementia care. Furthermore, a Delphi round with an expert panel further scrutinized the manual. Both evaluations (by health-care professionals and the expert panel) were used to optimize the manual into its final version. A strength of the EL training procedures as described in the EL manual is that a tailored approach is presented in which individually selected tasks can be trained. Professionals applied the EL working instruction by teaching patients with dementia a wide range of activities and deemed the instructions in the manual clear and feasible. Despite the positive feedback in the developmental phase of this manual, some concern was raised from care professionals about the limited time available to them to apply EL alongside standard care. One possible solution would be to practise tasks using EL as part of routine care, using the treatment time available for patients. In other words, EL could be embedded into daily practice. This would hardly increase the amount of time needed from the carer.

To our knowledge no other studies exist that examined the feasibility and treatment adherence of a standardized EL manual. Moreover, many previous studies did not report in detail how EL training was applied and what the exact error-reducing ingredients were. Therefore, the findings as described in chapters 2, 3 and 4 are relevant for clinical practice, since they demonstrate that a standardized EL manual is feasible and useful to teach people with dementia everyday-life tasks.

It should be noted that of the papers included in our literature review, several adopted a single-case approach. Although most of these single-case studies used good experimental designs that warrant good internal validity, their external validity is limited. The five group studies included in the review employed a control condition and randomization took place, but the number of participants was relatively small. Consequently, the findings from this review have to be interpreted with caution. To establish the effects of EL, randomized and controlled study designs using larger population samples are needed.

Secondly, the manual was only evaluated qualitatively using a questionnaire by experts and dementia care professionals, and treatment adherence was measured by rating the quality of performance of the therapists performing EL intervention. The EL intervention should therefore be considered as 'best practice', rather than evidence-based. Best practice is related to a process framework specifying how evidence is translated into day-to-day practice with ongoing monitoring an evaluation (Driever, 2002). Evidence-based refers to "approaches or treatments that are validated by some form of documented scientific evidence" (Spring, 2007). Although the working instructions described in the EL manual were based on earlier reviews on EL and thus based on the available scientific evidence, the effectiveness of the EL working instructions as proposed in the EL manual was not examined specifically. These limitations were addressed by our own RCT on EL, the results of which are discussed later in this chapter.

Rating the task performance of everyday-life tasks

Another question that was examined was how the effects of EL could be measured in clinical trials. To date, the assessment of everyday-life tasks performance in people with dementia is mostly limited to informant-based questionnaires on Instrumental Activities of Daily Living (IADL; Desai et al., 2004; Sikkes et al., 2012; Teunisse & Derix, 1997). In a systematic review of dementia specific-informant questionnaires, 12 IADL questionnaires were rated on eight psychometric properties. Information was lacking for many important measurement properties, such as the content validity, internal consistency, and reproducibility (Sikkes et al., 2009). Another disadvantage is that these questionnaires mostly rely on the informant's view on IADL performance, which is not always reliable and accurate. Furthermore, they only provide a global estimate of daily-life functioning, but do not provide information on the quality of everyday-life tasks performance. Therefore, there is a clear need for a more objective and quantitative measure of everyday-life tasks functioning in patients with Alzheimer's disease. Performance-based assessment provides such an objective behavioural evaluation of functional skills, by observing directly an individual enacting an everyday-life task. In studies by Dechamps et al. (2011) and Bourgeois et al. (2016), task performance was measured by counting the number of correct steps (i.e., the Task Performance Scale; TPS), which also took into account accuracy of the sequence of these steps. TPS was also used in a study that examined the effects of EL versus TEL in adults with brain injury (Bertens, Kessels, Fiorenzato, Boelen, & Fasotti, 2015).

While each of the abovementioned performance rating methods may be adequate for determining the effects of EL, none of these rating methods have been investigated with respect to their reliability and construct validity, or used for assessing every-day life abilities of people in their own homes. We therefore introduced and evaluated a new method to measure the effects of EL in a clinical trial. The results showed an excellent interrater reliability and a high concurrent validity, indicating that the newly developed Core-Elements Method (CEM) is a valid and reliable method to measure EL effects in clinical trials. Furthermore this method is easy to teach and to apply, in contrast to TPS which is complex and time-consuming.

Effectiveness of errorless learning

The final aim of this thesis was to examine the effectiveness of an EL intervention as described in our EL manual. The majority of previous studies taught patients with dementia artificial tasks with little or no relevance for their in daily lives. Furthermore, only a few controlled studies on EL have been performed so far and only a handful of studies have examined the long-term effects of EL. Moreover, large differences were found across studies in the types of tasks that were taught and the exact error-reducing methods that were used. Tasks were not always trained in the patients' natural or home environment, limiting the external validity of these studies.

A large multi-centre RCT (REDALI-DEM) was conducted (Voigt-Radloff et al., 2011) in which EL was compared to TEL in teaching people with AD or mixed-type dementia two everyday-life tasks at their homes. EL was found to improve the performance of everyday-life tasks and these improvements were maintained for six months. However, no difference was found in task performance between the EL and the TEL condition. That is, both EL and TEL methods were found to be equally effective in teaching patients with dementia everyday-life tasks.

This is the first large (N= 145) RCT on EL as a method to teach persons with dementia everyday-life tasks in a naturalistic setting. That is, the intervention was carried out in the patients' own homes, using relevant, self-chosen tasks. Qualitative reports showed that patients were satisfied with the intervention. In addition, the large sample size and low drop-out rate can be considered strengths of the study. Furthermore, all persons involved in the actual training of patients as well as the task performance raters were blinded for our hypotheses. Treatment adherence of the therapists was monitored using self- and external ratings, showing good treatment adherence. The planned sample size was reached in this RCT and the findings are reported according to the CONSORT guidelines, including long-term results, treatment costs and adverse events.

A methodological limitation of this study was that patients and therapists by definition were not blinded for the treatment itself, although measures were taken to prevent cross-over effects by letting therapists only give one type of intervention and keeping therapists naive to the hypotheses of the study. The finding that both methods improved the patients' task performance suggests there is a common underlying factor that facilitates learning in dementia. This factor may be the structured approach that activates the patient, rather than the error-reduction in itself.

Another recent RCT also found no differences in task performance of people with dementia after EL and TEL (Bourgeois et al., 2016). The authors proposed that this finding could be caused by the fact that the TEL approach, albeit not errorless in nature, results in learning as it requires more effort compared to EL teaching methods. Effortful processing may result in deeper encoding of what has been learned. Thus, this difference in depth of encoding may have obscured differences in task performance after TEL and EL. Possibly, a combination of effortful and errorless learning may produce even greater learning benefits. Several studies have examined approaches promoting active and deep encoding by, for instance, directing the patient's focus of attention to the to-be-learned information and creating semantic cues to self-generate the correct answer. This indeed has been shown to enhance the effects of EL (Laffan et al., 2010; Lubinsky et al., 2009; Tailby & Haslam, 2003). However, studies combining errorless and effortful learning of every-day-skills in dementia patients are lacking.

With respect to the efficacy and effectiveness of EL, reviews and empirical studies show that overall EL is beneficial in controlled studies using artificial tasks (Clare & Jones, 2008). Studies that found beneficial effects of EL compared to TEL or no treatment in teaching everyday-life tasks were mostly preliminary studies, or small scale trials, also showing promising results. However, the first two RCTs on EL of everyday-life tasks showed no additional effect of EL compared to TEL in patients with dementia. It is possible that EL is beneficial in some patients only, and future research should focus on predictors of positive learning outcomes in individual patients rather than group averages. The lack of a superiority effect of EL over TEL might also be explained by the fact that efficacy studies are by definition more controlled than effectiveness studies. In our RCT, a wide variety of everyday tasks was used in the intervention, rather than standardized tasks. Also, training took place in a natural environment, which may have resulted in more noise and variability, obscuring between-group differences.

Further research should also further examine how EL interventions can be integrated into clinical routines, and must determine what outcome measures and quality indicators are most suitable. These studies should not only focus on improvements in task performance, but should also address the effects of our proposed EL approach on quality of life, self-efficacy, mood and cognitive function of people with dementia. Also, potentially ameliorating effects on perceived stress levels of caregivers and families, and improvement of their quality of life should be examined, all compared to care as usual. Finally, it should be investigated in which type of dementia and severity of dementia EL is most beneficial, as this thesis did not provide a valuable contribution to this.

The results of these RCTs also raise questions about the underlying mechanism of EL. Studies usually refer to two possible frameworks. One theory is that the effect of EL relies on intact implicit memory systems (Baddeley & Wilson, 1994; Evans et al., 2000). The second theory suggest that the effect of EL relies on residual explicit memory function, rather than implicit memory functions (Hunkin et al., 1998; Kessels et al., 2005; Tailby & Haslam, 2003). In our RCT, patients were taught a task by learning a unique sequence of steps. This requires implicit learning (repeating the same sequence over and over again), but may also require explicit memory (thinking of a strategy or remembering former training sessions), as well as executive functioning, which is also compromised in dementia. Clare & Jones (2008) already suggested that EL could also be beneficial in executively impaired patients as well, since deficits in executive functioning lead to a deficit in error-monitoring systems. Errors are therefore not identified and patients will thus not correct these errors. A recent RCT in acquired-brain injury patients showed that preventing the occurrence of errors during learning in combination with a learning strategy enhanced the task performance in executively impaired individuals (Bertens et al., 2015). However, in patients with dementia, teaching a combinations of tasks and strategies is cognitively too demanding and not feasible.

Practical implications

The studies reported in this thesis have several implications for dementia care. The EL method consists of dividing everyday-life tasks into individual steps, modeling of the task steps by de therapist and providing verbal instructions. It is important that the training goals and training intensity are tailored, which means that the to-be-trained task should fit the needs of the patient (i.e., the patient is motivated to (re)learn the task), that the estimated goal is realistic (what is achievable based on the cognitive and physical condition of the patient), and that the training takes place in a familiar environment, with the patients' own materials and appliances.

In addition to the application of EL in teaching everyday-life tasks, the principle of EL can also be used in the day-today interaction with people with dementia. In particular, the emphasis on providing specific cues and avoiding open questions or ambiguous instructions is essential in everyday interaction with people with dementia. For example, asking open-end questions assumes that the person understands what is asked and why, and that s/he is able to search her/his memory for a specific, adequate response. This is obviously very challenging for many people with dementia. An approach in which closed or directive questions are asked which prompt the patients towards the correct answer or response is thus preferred. Such an approach may facilitate conversation and may reduce stress for the patient.

In dementia care, tasks are often taken over from patient, in order to save time. However, EL provides a possibility to perform tasks together with patients or, in optimal conditions, tasks can be relearned by patients and performed (partly) independently. The advantage for patients is that EL, by its very definition, provides a success experience. The difficulty level is always chosen to guarantee a positive outcome and mistakes are prevented. This may provide patients with a sense of success, instead of yet another experience of failure. Involving people with dementia in an activity may increase their sense of self-esteem, safety, degree of independence and quality of life. In short, implementation of EL, whether done at task or skill level, or as a principle to guide the interaction with persons with dementia, may optimize a positive and pleasant interacting with patients who were long believed incapable of (re)learning tasks. However, further research should examine the effects of EL on mood, self-esteem and quality of life in people with dementia as so far.

Conclusion

This thesis presents an overview of the development and evaluation of an EL manual, the validity and reliability of a new assessment procedure to rate the performance of everyday-life tasks and the examination of the effectiveness of EL in the REDALI-DEM RCT. The EL working instructions in the manual were well received by professionals working in dementia care and were found to be feasible. The newly developed Core Elements Method was found to be reliable, valid and easy-to-perform, and can be used for assessing everyday-task performance in clinical trials. The results from the REDALI-DEM RCT showed that while task performance improved after EL, it did not have an additional effect on task performance compared to TEL. Future studies should therefore focus on the factors that determine learning success in individual patients rather than group averages. To date, it is too early to recommend the exclusive implementation of EL in dementia care at a large scale. Rather, EL is one of many techniques that can be applied in dementia care, facilitating participation and interaction in a positive way.

Supplementary material

Appendix A

English adaptation of the full feasibility survey among geriatric/dementia professionals and skill domain concepts in italics.

	Question	*Concept*
1	In what kind of care facility do you work?	Intramural Extramural Private residence
2	What is your discipline?	Psychologist Physician (MD) Nurse (practitioner) Occupational therapist Speech therapist Physiotherapists Activity coordinators
3	Total working hours per week	8-16 hours 17-24 hours 25-36 hours
4	How many years in total have you worked in this capacity?	<1 year 1-5 year 6-10 year 11-15 year 16-20 year > 20 year
5	How many years have you worked in the current facility?	<1 year 1-5 year 6-10 year 11-15 year 16-20 year > 20 year
6	Which patients residing in your facility will benefit (most) from an errorless learning approach to (re)learn skills?	Mild cognitive impairment (MCI) Mild dementia Moderate dementia Severe dementia
6a	Others, namely	Traumatic brain injury (TBI) Neurodegenerative diseases Korsakoff's syndrome Other
7	In which care facilities would EL be applicable?	Day clinic Day care centre Rehabilitation unit Special care unit Somatic unit
7a	Other namely,	At the patient's home

	Question	*Concept*
8	Which tasks/activities/skills are currently being (re)taught in your facility?	Activities of daily living (ADL) Instrumental activities of daily living (IADL) Mobility skills Orientation skills Leisure activities None
9	Besides yourself, which other professionals are involved in teaching mentioned tasks/skills/ activities?	Psychologist Nurse / Nurse practitioner Nursing assistant Informal caregiver Occupational therapist Physiotherapists
10	Which teaching methods are currently being used in your facility?	Visual guidance Verbal guidance Structuring/simplifying tasks + providing feedback Incidental learning
11	What would get in the way of patients with dementia (re)learning tasks or skills?	Limitations of the patient Poor implementation Poor prerequisites
12	What would facilitate patients with dementia to (re)learn tasks or skills?	Patients' residual capacities Good implementation Good prerequisites
13	Which other tasks, skills or activities could patients with dementia residing in your facility (re)learn?	ADL IADL Mobility skills Orientation skills Leisure activities
14	Do you think it is relevant to help patients with dementia (re)learn activities or skills?	Yes No
15	Which disciplines should be involved in (re) training these skills?	Psychologist Occupational therapist Physiotherapist Nurse / Nurse practitioner Nursing assistant Activity coordinator Informal caregiver
15a	Other, namely,	-
16	Which role could the informal caregiver play in helping the patient with dementia (re)learn these skills?	Purposeful guidance Supportive guidance
17	How many hours will the psychologist be able to spend on skill training overall?	<1 1-10 11-20 21-30 31-40

	Question	*Concept*
18	How many hours will the physiotherapist be able to spend on skill training overall?	<1 1-10 11-20 21-30 31-40
19	How many hours will the occupational therapist be able to spend on skill training overall?	<1 1-10 11-20 21-30 31-40
20	How many hours will the activity coordinator be able to spend on skill training overall?	<1 1-10 11-20 21-30 31-40
21	How many hours will the nurse / nurse practitioner / nursing assistant be able to spend on teaching these tasks overall?	<1 1-10 11-20 21-30 31-40
22	Other, namely:	Patient-dependent
23	How many days per week?	<0.5 day 1 day 2 days 3 days 4 days 5 days
24	Can training interventions be repeated ?	Yes No
24a	Reason	Organizational/practical factors Patient Facility structure
25	Can training interventions be repeated over longer periods of time?	Yes No
25a	Reason	Organizational/practical factors Patient Facility structure
26	Which disciplines should be involved in prolonged training?	Psychologist Occupational therapist Physiotherapist Nurse / Nurse practitioner Nursing assistant Activity coordinator Informal caregiver
26a	Other, namely	Other

	Question	*Concept*
27	Who has the most problems with the patient's inability to perform certain tasks or his/her loss of skills?	Patient Psychologist Occupational therapist Physiotherapist Nurse / Nurse practitioner Nursing assistant Activity coordinator Informal caregiver
27a	Other, namely	Other
28	What are the benefits of (re)learning skills for the patients?	Autonomy Well-being Activation
29	What are the benefits of patients (re)learning skills for the informal caregivers?	Reducing care burden Improving well-being Enhancing quality (spousal) relationship Other
30	What are the benefits of patients (re)learning skills for nursing staff?	Enhancing quality patient-staff relationship Reducing professional burden Enhancing quality of care provided Other
31	What are the benefits of patients (re)learning skills for psychologists?	Improving patient well-being Reducing professional burden Enhancing quality of care provided Other
32	What are the benefits of patients (re)learning skills for physiotherapists?	Improving patient mobility Reducing professional burden Enhancing quality of care provided Other
33	What are the benefits of patients (re)learning skills for occupational therapists?	Increasing patient autonomy Reducing professional burden Enhancing quality of care provided Other
34	What are the benefits of patients (re)learning skills for activity coordinators?	Increasing engagement in leisure activities / patient is stimulated Reducing professional burden Enhancing quality of care provided Other
35	Other advantages?	None
36	What are the disadvantages of (re)learning skills for the patients?	Increasing burden Other
37	What are the disadvantages of patients (re) learning skills for informal caregivers?	Increasing care burden (Unrealistic) expectations Requiring flexibility

	Question	*Concept*
38	What are the disadvantages of patients (re) learning skills for nurses?	Increasing professional burden (Unrealistic) expectations Requiring professional flexibility Other
39	What are the disadvantages of patients (re) learning skills for psychologists?	Increasing professional burden (Unrealistic) expectations Requiring professional flexibility Other
40	What are the disadvantages of patients (re) learning skills for physiotherapists?	Increasing professional burden (Unrealistic) expectations Requiring professional flexibility Other
41	What are the disadvantages of patients (re) learning skills for occupational therapists?	Increasing professional burden (Unrealistic) expectations Requiring professional flexibility Other
42	What are the disadvantages of patients (re) learning skills for activity coordinators?	Increasing professional burden (Unrealistic) expectations Requiring professional flexibility Other
43	Other disadvantages?	None
44	What factors would facilitate skill (re)training in your facility/organization?	Good implementation Good prerequisites Other
45	What factors would hamper skill (re)training in your facility/organization?	Poor implementation Poor prerequisites Other
46	What would make it possible to help patients with dementia (re)learn tasks/skills using the EL method in your facility?	Good implementation Good prerequisites Residual capacities of the patient
47	What would make it unfeasible to help patients with dementia (re)learn tasks/ skills using the EL method in your facility?	Limitations of the patient Poor implementation Poor prerequisites
48	Will structured interdisciplinary communication about and transfer of EL procedures and programmes be possible?	Yes No
49	With a patient-specific care plan in place, will other disciplines in your facility adopt the exact same approach?	Yes No Sometimes Don't know
50	Additional feedback, comments, recommendations	

Appendix B

Errorless learning - training evaluation form

1. **Name facility:**
2. **Name therapist:**
3. **Discipline:**
4. **Client diagnosis:**
   - ☐ MCI/VCI
   - ☐ Alzheimer dementia
   - ☐ Vascular dementia
   - ☐ Mixed dementia
   - ☐ Korsakoff's syndrome
   - ☐ Stroke
   - ☐ Other, namely:
5. **Dementia severity:**
   - ☐ Mild
   - ☐ Moderate
   - ☐ Severe
   - ☐ Other, namely:
6. **MMSE score: _______**
7. **The task/activity/skill trained: _______**
8. **Total number of sessions: _______**
   Session duration: _______ mins.
9. **The client was motivated to learn the task/activity/skill**

Fully agree	1	2	3	4	Fully disagree

10. **The client enjoyed training the task/activity/skill**

Fully agree	1	2	3	4	Fully disagree

11. The client is now able to perform the task more independently than before the start of the intervention

Fully agree	1	2	3	4	Fully disagree

12. EL was most useful in training the client

Fully agree	1	2	3	4	Fully disagree

13. It was possible to train the task in steps

Fully agree	1	2	3	4	Fully disagree

14. It was possible to prevent errors from being made using the EL method

Fully agree	1	2	3	4	Fully disagree

15. It was possible to correct errors using the EL method

Fully agree	1	2	3	4	Fully disagree

16. It was possible to fade out the support required

☐ Yes
☐ No
☐ Please specify:

17. Did you make use of additional tools during the training sessions?

☐ Yes
☐ No
☐ If Yes, please specify:

18. Did you modify the EL procedure as described in the manual?

☐ Yes
☐ No
☐ If Yes, please specify:

19. The manual helped clarify ambiguities

Fully agree	1	2	3	4	Fully disagree

20. The information in the manual is relevant and complete

- ☐ Yes
- ☐ No
- ☐ Comment:

21. I was able to fit in EL training in my usual workload

- ☐ Yes
- ☐ No
- ☐ If No, please specify reason(s):

22. Communication about EL training sessions and transfer among care disciplines was effective

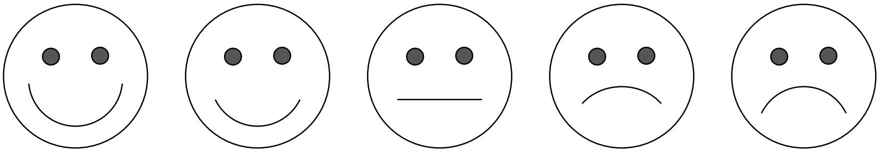
Fully agree	1	2	3	4	Fully disagree

23. Other comments

Appendix C

Client evaluation form

How do you feel about today's training session?



Appendix D

Characteristics of the therapists

Site	Men/ Women*	Qualification	Years in the field	Cases
		Errorless learning		
Bonn	W	OT	5	7
Freiburg	W	OT	10	1
Freiburg	W	OT	6	21
Freiburg	W	OT	3	2
Mainz	M	OT	9	11
Mainz	M	PS	1	1
Marburg	W	PS	1	9
Marburg	M	PS	1	3
Tübingen	W	OT	18	12
Tübingen	W	OT	4	4
Mannheim	M	OT	3	10
Total Mean (SD)			5.5 (5.1)	7.4 (6.1)
		Trial and error learning		
Bonn	W	OT	6	2
Bonn	W	OT	3	4
Freiburg	W	OT	6	29
Mainz	W	PS	1	5
Mainz	W	PS	3	3
Mainz	W	PS	1	5
Marburg	W	OT	15	12
Tübingen	M	PS	4	6
Tübingen	W	SO	5	7
Mannheim	W	OT	4	7
Total Mean (SD)			4.8 (4.0)	8.0 (7.9)

*M: Man; W: Woman; OT: Occupational Therapist; PS: Psychologist; SO: Social Worke

Appendix E

Resource utilization following structured relearning of individually selected daily living tasks

	Sample errorless *N*	**Sample** trial & error *N*	**Baseline** errorless mean (SD)	**Baseline** trial & error mean (SD)	**Week 11** errorless mean (SD)
Resource Utilization					
Treatment hours (SD)	69	71			25.9 (0.8)
Treatment costs, EURO (SD)	69	71			1551.30 (47.5)
RUD resource utilization during last two weeks					
Nights in hospital (SD)	69	71	0.3 (1.7)	0.4 (2.3)	
Nights in short-term nursing care (SD)	69	71	0.0 (0.0)	0.0 (0.0)	
Contacts with general practitioner (SD)	69	71	0.5 (0.6)	0.4 (0.6)	
Contacts with specialist (SD)	69	71	0.4 (0.7)	(0.4 (1.0)	
Number of purchased devices (SD)	69	71	0.1 (0.4)	0.1 (0.3)	
Hours community therapy service (SD)	69	71	0.3 (0.9)	0.2 (1.0)	
Hours community group service (SD)	69	71	0.6 (2.0)	2.4 (4)	
Hours community nursing service (SD)	69	71	0.7 (2.3)	0.6 (2.3)	
Hours community support service (SD)	69	71	7.3 (39.8)	3.6 (11.7)	
Hours of active support by primary caregiver (SD)	68/67/66*	71/69/67*	5.7 (4.4)	6.4 (4.8)	
Hours of supervision by primary caregiver (SD)	68/67/66*	71/69/67*	0.7 (4.1)	0.3 (2.8)	
Intake of cholinergic drugs, mg per day (SD)	69/67/66*	71/69/68*			
Donezepil			3.0 (4.2)	3.3 (4.3)	
Rivastigmin			0.6 (2.2)	0.9 (2.6)	
Galantamin			0.7 (4.1)	0.3 (2.8)	
Memantin, (Ebixa)			0.1 (0.8)	0.6 (3.3)	
Memantin, (Axura)			3.0 (6.8)	1.7 (5.6)	

*numbers represent *n* at: baseline / week 16 / week 26. Abbreviations: SD, Standard Deviation; *= p<0.05

Week 11 trial & error mean (SD)	Week 11 group Δ mean [95%-CI]	Week 16 errorless mean (SD)	Week 16 trial & error mean (SD)	Week 16 group Δ mean [95%-CI]	Week 26 errorless mean (SD)	Week 26 trial & error mean (SD)	Week 26 group Δ mean [95%-CI]
26.0 (0.6))	0.1 [-0.1,0.4]				5.9 (0.3)	5.6 (1.2)	-0.3 [-0.6, 0.0]
1560.0 (35.1))	8.7 [-5.3,22.7]				355.7 (18.7)	337.2 (71.3)	-18.5 [-35.9,-1.1]
		0.0 (0.0)	0.13 (1.1)	0.1 [-0.1, 0.4]	0.1 (0.7)	0.2 (1.6)	0.1 [-0.3;0.5]
		0.0 (0.0)	0.0 (0.0)	0.0 []	0.2 (1.7)	0.2 (1.3)	-0.0 [-0.6;0.5]
		0.5 (0.8)	0.4 (0.6)	-0.1 [-0.3, 0.1]	0.5 (0.7)	ß.4 (0.5)	-0.1 [-0.3;0.1]
		0.1 (0.3)	0.3 (0.5)	0.2 [0.0, 0.4]	0.2 (0.4)	0.2 (0.5)	0.0 [-0.2,0.1]
		0.1 (0.4)	0.1 (0.3)	0.0 [-0.1,0.1]	0.1 (0.4)	0.1 (0.4)	0.0 [-0.1,0.1]
		0.2 (0.5)	0.2 (1.0)	0.0 [-0.2,0.3]	0.2 (0.6)	0.2 (0.7)	0.0 [-0.2,0.2]
		1.6 (5.6)	3.8 (10.2)	2.3 [-0.5,5.0]	2.4 (7.1)	4.4 (11.1)	2.0 [-1.1,5.1]
		0.8 (2.4)	0.9 (2.1)	0.0 [-0.7,0.8]	1.1 (3.4)	0.8 (2.0)	-0.3 [-1.2,0.7]
		7.8 (40.0)	(11.2 (53.6)	3.4 [-12.4,19.2]	7.9 (41.7)	12.9 (55.1)	5.0 [-11.3,21.4]
		7.5 (5.7)	8.2 (5.4)	0.7 [-1.1, 2.6]	8.4 (5.2)	8.4 (5.2)	0.0 [-1.7,1.8]
		5.5 (6.0)	4.1 (5.5)	-1.4 [-3.3, 0.6]	5.0 (5.2)	4.4 (5.1)	-0.7 [-2.4,1.1]
		4.6 (5.0)	4.9 (4.8)	0.2 [-1.4,1.9]	4.8 (4.8)	5.0 (4.7)	0.2 [-1.4,1.8]
		0.6 (2.3)	1.1 (3.1)	0.3 [-0.4,1.4]	0.5 (2.1)	1.2 (3.1)	0.7 [-0.2,1.6]
		0.7 (4.1)	0.4 (2.9)	-0.4 [-1.6,0.8]	0.4 (2.9)	0.7 (4.1)	-4 [-1.6,0.8]
		0.5 (2.7)	0.3 (2.4)	-0.2 [-1.0,0.7]	1.1 (3.6)	0.3 (2.4)	-0.8 [-1.8,0.3]
		3.5 (8.4)	2.3 (6.5)	-1.2 [-3.7,1.4]	3.1 (7.4)	2.1 (6.1)	-1.0 [-3.4,1.3]

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Nederlandse samenvatting

Iedereen vergeet weleens wat in alledaagse situaties: het voornemen om iemand te bellen, wat men precies had afgesproken, of wat men zojuist bedacht had om te gaan pakken. Veel mensen merken dat bij het ouder worden het geheugen achteruitgaat. Dit komt doordat naarmate we ouder worden, bepaalde hersenfuncties langzaam afnemen: we worden mentaal langzamer, vergeetachtiger en minder flexibel. Dementie is echter iets anders dan 'normale veroudering'. Men spreekt van een dementie wanneer de achteruitgang van cognities zo ernstig is, dat iemand zich niet meer zelfstandig kan redden in het dagelijks leven. Dementie wordt dan ook veroorzaakt door een hersenziekte, een progressieve aandoening, waarbij de hersenfuncties langzaam verder achteruitgaan. Hierdoor worden de cognitieve problemen steeds groter, met een afname in zelfstandigheid tot gevolg. Geheugenstoornissen zijn het meest prominent aanwezig bij dementie. Naast geheugenverlies zijn er bij dementie ook andere denkfuncties die achteruit kunnen gaan. Zo kunnen er problemen ontstaan in de oriëntatie, waardoor mensen verdwalen of de datum en dag niet meer weten. Ook het herkennen van voorwerpen kan een probleem worden. Daarnaast kan het denk- en redeneervermogen achteruitgaan, waardoor mensen minder abstract kunnen denken en problemen krijgen met plannen maken of oplossingen bedenken. Tevens kunnen mensen met dementie moeite krijgen met het uitvoeren van handelingen; ze weten dan niet meer waar voorwerpen voor dienen en kunnen deze niet meer juist gebruiken. Daarbij kunnen mensen met dementie trager worden in het nadenken en hierdoor langzaam reageren, of problemen hebben met het spreken en begrijpen (denk aan niet op woorden kunnen komen of een gesprek niet begrijpen). Tot slot kan ook het gedrag veranderen, waardoor mensen met dementie op ongepaste momenten lachen of huilen, gaan dwalen, doelloos zoeken, achterdochtig worden, of gebrek aan ziekte-inzicht laten zien. Vooralsnog is er geen medicatie die de ziektes die tot dementie leiden, zoals de ziekte van Alzheimer, kan genezen. Door de vergrijzing neemt het aantal mensen met dementie de komende tijd naar verwachting toe. Mede door de problemen die daarmee gepaard gaan zullen de kosten in de zorg blijven toenemen.

Geheugenstoornissen bij dementie

Grofweg is het geheugen in te delen in een expliciet (bewust) geheugen en een impliciet (onbewust) geheugen. Het expliciete geheugen is de verzameling bewuste herinneringen aan feiten en gebeurtenissen. Het impliciete geheugen omvat geleerde vaardigheden en de mogelijkheid om op een bepaalde wijze te reageren op basis van eerdere ervaring. Het impliciete geheugen is als het ware een automatisch geheugen, waarbij indrukken, ervaringen en emoties die men opdoet worden opgeslagen zonder zich hiervan bewust te zijn.

Bij dementie is vooral het expliciete geheugen beschadigd. Mensen met dementie zijn minder goed in staat om nieuwe, bewuste herinneringen aan te maken en op te diepen. Vragen zoals wat men gisteren gedaan heeft, met wie men gesproken heeft, of hoe men een bezigheid aangepakt had, zijn niet of nauwelijks te beantwoorden voor iemand met dementie. Daarentegen blijkt dat personen met (beginnende) dementie vaak heel goed nog bezigheden kunnen uitvoeren, zoals eten klaarmaken, thee zetten, tafel dekken, of zich aankleden, al dan niet met een beetje hulp of bijsturing. Het zijn ingeslepen vaardigheden die geautomatiseerd zijn en die weinig bewuste aandacht vragen. Met behulp van een kleine hint, zoals de eerste stap van een bezigheid, kan iemand met dementie toch in staat zijn om de bezigheid zelfstandig te voltooien, omdat de ene stap de volgende stap vanzelf oproept. Bij de aanhef van een bekend lied kan iemand met dementie het volledige lied meezingen en in de context van de kerk kan iemand gemakkelijk gebeden opdiepen, omdat de klanken en de context associaties oproepen. Mensen met dementie kunnen dus wel nog gebruik maken van deze automatische geheugenfuncties, zowel bij het opnemen als bij het opdiepen van informatie. Zij blijken zelfs in staat om nieuwe vaardigheden en associaties te leren wanneer de dementie niet al te ver gevorderd is: iemand die verhuisd is, kan in het nieuwe huis leren de weg te vinden naar het toilet en leren in welke kast de kopjes staan. Het feit dat impliciete geheugenprocessen relatief gespaard blijven met het voortschrijden van de dementie roept onmiddellijk de vraag op of dit wellicht een ingang is om het lerend vermogen te bevorderen.

Foutloos leren

Een specifieke methode die gebruik maakt van het impliciete leren is foutloos leren (FL). Deze benadering is gebaseerd op het idee dat het leren beter gaat wanneer fouten tijdens de aanleerfase worden voorkomen. Uit onderzoek blijkt namelijk dat fouten die gemaakt worden tijdens het leren van informatie automatisch worden vastgelegd in het geheugen en tot uiting kunnen komen bij het opnieuw uitvoeren van de geleerde handeling en het opdiepen van de informatie. Bij gezonde mensen, zonder stoornissen in het expliciet geheugen, zullen deze fouten opgemerkt en gecorrigeerd worden. Echter, bij mensen met ernstige geheugenstoornissen zijn de hersenen verminderd in staat om onderscheid te maken tussen 'juiste' en 'verkeerde' informatie. Hierdoor worden fouten niet goed opgemerkt en gecorrigeerd, zodat ze vastgelegd en mee aangeleerd worden. Door het voorkómen van fouten in de fase van aanleren zal alleen de juiste informatie worden opgeslagen in het geheugen.

FL is een methode waarbij er door de behandelaar of therapeut inspanning wordt geleverd om fouten te voorkomen. De behandelaar zorgt ervoor dat de leersituatie zo wordt ingericht, dat het maken van fouten tot een minimum wordt beperkt en dat er niet gegokt of geraden hoeft te worden naar de gewenste antwoorden of handelingen. Dat betekent dat er een belangrijke en sturende rol voor de behandelaar is weggelegd en dat deze de persoon met dementie actief begeleidt in het leren. Deze manier staat haaks op het zogenaamde *trial-and-error*-leren (TEL), waarbij de persoon de activiteit uitvoert en pas achteraf feedback krijgt of gecorrigeerd wordt. *Trial-and-error*-leren impliceert dat de persoon zelf uitzoekt hoe de activiteit het beste gedaan kan worden en zelf naar oplossingen zoekt bij moeilijkheden. Deze aanpak wordt ook wel 'ontdekkend leren' genoemd. Het leren vindt dan plaats door uitproberen, door vallen en opstaan, en het doet een groot beroep op iemands inzicht in de eigen prestaties. Het veronderstelt dat de persoon onderscheid kan maken tussen wat goed gaat en wat niet, kan onthouden wat er lukte en wat niet, onthoudt wat het gewenste einddoel is en hier naar toe kan werken, creatief en zelfstandig naar oplossingen kan zoeken, zichzelf kan sturen en corrigeren, en overzicht kan bewaren. Het moge duidelijk zijn dat juist deze vermogens bij mensen met dementie verminderd aanwezig zijn. Niettemin is dit ontdekkend leren een gangbare manier in de klinische praktijk om mensen te bejegenen en te onderwijzen.

FL is onderzocht bij patiënten met geheugenstoornissen ten gevolge van bijvoorbeeld traumatisch hersenletsel, beroerte (CVA), het syndroom van Korsakov, of schizofrenie en bij oudere personen met lichte, matige of ernstige geheugenstoornissen, zoals dementie. Een goed overzichtsartikel is geschreven door (Clare en Jones, 2008). FL is echter vooral onderzocht in zogenaamde laboratoriumstudies. Dus, onderzoeken waarin vooral met kunstmatige pen-en-papiertaken of computertaken onderzocht is of FL al dan niet werkt (Clare en Jones, 2008; Middleton en Schwartz, 2012). Het is tot op heden echter nog onduidelijk in hoeverre FL effectief is bij het aanleren van (instrumentele) activiteiten in het dagelijks leven ((I)ADL). Daarnaast hebben veel studies niet onderzocht hoe lang het eenmaal geleerde beklijft. Bovendien is er geen handleiding beschikbaar die professionals een werkinstructie biedt hoe FL in de praktijk zou moeten worden toegepast en hoe FL kan worden ingebed in de klinische praktijk. Dit proefschrift zal ingaan op deze vragen.

Bij aanvang van dit project was er geen informatie beschikbaar over hoe FL in de klinische praktijk moest worden toegepast. Het proefschrift begint dan ook met een literatuurstudie naar eerder onderzoek naar FL bij het leren van alledaagse taken aan mensen met een dementie (**Hoofdstuk 2**). De resultaten van deze literatuurstudie toonden aan dat het voor personen met dementie mogelijk is om alledaagse taken aan te leren middels FL. Dit effect werd aangetoond in vijf gecontroleerde groepsstudies en elf gevalsstudies. Daarnaast lieten verschillende onderzoeken zien dat positieve FL-effecten na afloop van de training ook na enkele weken tot enkele maanden bleven bestaan.

Daarnaast gaven de resultaten uit deze literatuurstudie ook informatie over hoe FL kan worden toegepast in de praktijk. Zo kunnen procedurele taken (vaardigheden) het beste worden aangeleerd door de taak op te delen in stappen, waarbij de trainer of therapeut de deelstappen voordoet en verbaal begeleidt. *Vanishing cues* kunnen worden gebruikt om de mate van hulp geleidelijk aan af te bouwen. De intensiteit en duur van de training blijkt sterk afhankelijk van de te leren taak, de ernst van dementie en de persoon met dementie zelf. Het wordt dus aangeraden om elke training op het individu aan te passen en de training moet plaatsvinden in een voor de persoon met dementie bekende omgeving.

In hoofdstuk 3 wordt de ontwikkeling en de evaluatie van de FL-handleiding beschreven. Om de handleiding te kunnen ontwikkelen werden professionals, werkzaam in verpleeg-huizen, allereerst gevraagd een vragenlijst in te vullen. Middels deze vragenlijst werd de behoefte geïnventariseerd die er in de verpleeghuispraktijk bestaat naar een gestructureerde leermethode. Bovendien werd beoogd informatie in te winnen over een aantal praktische zaken in verpleeghuizen, zodat er een juiste inschatting gemaakt kon worden van de toepassingsmogelijkheden van de FL methode. De resultaten uit deze vragenlijst en de literatuurstudie uit hoofdstuk 2 werden gebruikt om de handleiding te ontwikkelen. Deze concepthandleiding is vervolgens geëvalueerd door professionals te vragen de handleiding in de klinische praktijk uit te proberen. Daarnaast werd er een panel van onafhankelijke beoordelaars geselecteerd om de concepthandleiding te evalueren. Deze professionals werd niet gevraagd om de handleiding daadwerkelijk toe te passen, maar deze te lezen, te beoordelen middels de AGREE-lijst en eventueel aanvullende commentaren te geven. De concepthandleiding werd op basis van deze evaluaties verder aangepast.

De reacties van de deelnemers aan de implementatie-ronde waren overwegend positief. Zorgprofessionals gaven aan dat er in de praktijk behoefte is aan handvatten en concrete aanwijzingen om mensen met dementie te benaderen en te helpen leren. Er werd opgemerkt dat het middels FL mogelijk is om mensen met dementie activiteiten aan te leren. Ook waren respondenten enthousiast over het feit dat deze benadering gebruik maakt van wat mensen met dementie nog wél kunnen, in plaats te benadrukken wat men niet meer kan.

In **hoofdstuk 4** wordt onderzocht in hoeverre de therapeuten in de REDALI-DEM pilot-studie de protocollen van beide leercondities (FL en TEL) correct uitvoerden. Deze pilot-studie was onderdeel van de REDALI-DEM gerandomiseerde en gecontroleerde studie (*randomized controlled trial* of RCT) waarin FL werd vergeleken met trial-and-error-leren bij het aanleren van alledaagse taken aan mensen met een dementie in de thuis-situatie. Door middel van video-observaties werden de therapeuten door twee beoordelaars beoordeeld.

De resultaten lieten zien dat de beoordelingen gegeven door de twee beoordelaars in hoge mate met elkaar overeenkwamen. Het bleek dat naarmate het aantal trainings-sessies vorderde, therapeuten steeds beter werden in het uitvoeren van de training (FL of TEL). De uitvoering van de protocollen was aan het einde van de hele behandeling voor alle therapeuten van voldoende kwaliteit. Er werd geen verschil gevonden in de kwaliteit van uitvoering tussen de twee protocollen (FL en TEL).

De resultaten laten zien dat het mogelijk is om een gestandaardiseerde FL protocol toe te passen om zo mensen met een dementie in de thuissituatie alledaagse taken aan te leren. Het protocol bleek toepasbaar bij verschillende mate van ernst van dementie en kon worden gebruikt om een variatie van taken aan te leren. De resultaten van deze studie werden daarnaast gebruikt om de studieprocedures te verfijnen voor de start van de REDALI-DEM RCT studie.

In **hoofdstuk 5** wordt de validiteit en de betrouwbaarheid van een nieuwe beoordelingsmethode onderzocht: de *Core Elements Method* (CEM). Tot nu toe werd het effect van FL met name onderzocht door het correct aantal uitgevoerde stappen te tellen, of door gebruik te maken van de *Task Performance Scale* (TPS). Dit is een schaal waarbij er ook rekening wordt gehouden met de kwaliteit van de uitgevoerde stappen van een activiteit. CEM daarentegen beoordeelt gebundelde stappen in plaats van individuele stappen middels een zevenpuntsschaal. De betrouwbaarheid en validiteit van CEM werden onderzocht door CEM en TPS te gebruiken bij het beoordelen van de taakprestatie van patiënten met alzheimerdementie, die allen ook deelnamen aan de REDALI-DEM RCT.

Uit de resultaten bleek dat de interbeoordelaarsbetrouwbaarheid van beide beoordelingsmethoden hoog was. Daarnaast kwamen de beoordelingen van CEM en TPS in hoge mate met elkaar overeen. Beide beoordelingsmethoden kunnen dus worden gebruikt om de effectiviteit van FL leren te onderzoeken. Voor de klinische praktijk wordt echter CEM boven TPS aanbevolen, omdat deze methode minder complex en minder tijdrovend is om aan te leren en uit te voeren.

Hoofdstuk 6 beschrijft de resultaten van de REDALI-DEM RCT waarin het effect van FL werd vergeleken met TEL in het leren van alledaagse taken in de thuissituatie aan mensen met een dementie. Een groep van 145 patiënten kreeg 13 trainingen van 1 uur, verdeeld over 10 weken (2 taken per training) waarbij de patiënten of aan de FL-conditie of aan de TEL-conditie werden toegewezen. De prestatie op de taak werd gemeten voor aanvang van de trainingen en in week 16 (6 weken na afloop van de training). Door middel van video-observaties, die werden beoordeeld door onafhankelijke beoordelaars, werd de prestatie op de gekozen taken gemeten. Secundaire uitkomstmaten waren de prestatie op de taak in week 26, de mate van hulp die de patiënt nodig had, de tevredenheid van de patiënt over de training, gedrag, nadelige gebeurtenissen en de kosten van de behandeling.

71 patiënten kregen de FL conditie en 74 patiënten kregen de TEL conditie toegewezen. *Intention-to-treat* (ITT) analyses lieten in week 16 in beide groepen een significante verbetering in de prestatie op de twee taken zien. TEL en FL bleken beiden even effectief in het aanleren van een alledaagse taak aan mensen met een dementie in de thuissituatie. De effecten bleven behouden na 6 maanden.

De resultaten laten zien dat het mogelijk is om mensen met een dementie een alledaagse taak in de thuissituatie aan te leren. FL zorgde er bij deze groep dementie-patiënten in de thuissituatie echter niet voor dat het aanleren van taken beter verliep dan TEL.

Conclusie

De studies in dit proefschrift beschrijven de ontwikkeling en evaluatie van een FL handleiding, de validiteit en betrouwbaarheid van een nieuwe beoordelingsmethode voor het beoordelen van de uitvoering van alledaagse taken en het effect van FL zoals is onderzocht in de REDALI-DEM RCT.

De resultaten laten zien dat het mogelijk is om een gestandaardiseerde FL handleiding toe te passen om zo mensen met een dementie in de thuissituatie alledaagse taken aan te leren. De handleiding bleek toepasbaar bij verschillende mate van ernst van dementie en kon worden gebruikt om een variatie van taken aan te leren. De nieuw ontwikkelde Core Elements Method bleek een valide en betrouwbaar instrument voor het beoordelen van het uitvoeren van alledaagse taken. Daarnaast bleek deze methode ook makkelijk aan te leren aan therapeuten en goed uitvoerbaar. De REDALI-DEM RCT studie liet zien dat TEL en FL beiden even effectief zijn in het aanleren van een alledaagse taak aan mensen met een dementie in de thuissituatie. Het is op dit moment daarom te vroeg om FL aan te bevelen om toe te passen op grote schaal in de dementiezorg. FL is een methode die goed toepasbaar is bij mensen met een dementie en die ook faciliteert in een positieve benadering en kan bijdragen in de activatie en interactie.

Dankwoord

Het is zover, het proefschrift is af. Het heeft enkele jaren geduurd waarbij ik naast mijn klinische werk elke keer tijd vrijmaakte voor dit project. Dit proefschrift was niet tot stand gekomen zonder de hulp van vele anderen. Hier wil ik dan ook iedereen bedanken voor zijn of haar hulp.

Allereerst gaat mijn dank uit naar alle therapeuten en deelnemers aan de studies voor een belangeloze deelname. Zonder hen zou er geen proefschrift en onderzoek zijn geweest. Dankzij financiering door Stichting Devon en het Nuts Ohra Fonds was het mogelijk om dit traject te starten en ook af te ronden.

Beste prof. dr. Kessels, beste Roy, vanwege jouw enthousiasme, eeuwige optimisme en pragmatisch denken bleef ik het vertrouwen houden dat ik het project tot een goed einde zou brengen. Ik heb erg veel bewondering dat je ondanks je erg drukke agenda altijd tijd voor me maakt. Door jouw goede executieve functies (schakelvaardigheid, probleemoplossend vermogen en overzicht houden) maakte het dat je het voor elkaar kreeg om een probleem waarmee ik zat binnen enkele minuten op te lossen (al duurde de uitvoering hiervan voor mij vaak wat langer). Ik wil je heel erg bedanken voor alle discussies, maar ook persoonlijke gesprekken die we hebben gevoerd. Ik heb erg veel van je geleerd en ik had me geen betere begeleider kunnen wensen.

Beste prof. dr. Olde Rikkert, Beste Marcel, ik wil je bedanken voor je betrokkenheid en meedenken in dit project. Door jouw commentaar werden de artikelen naar een hoger niveau getild.

Beste dr. Boelen, Beste Daniëlle, bedankt dat je me wegwijs hebt gemaakt in de bijzondere wereld die onderzoek heet. Jouw gestructureerde manier van werken, kritische en brede blik hebben ervoor gezorgd dat ik me door de jaren heen als onderzoekster heb kunnen ontwikkelen en hebben een belangrijk bijdrage geleverd aan dit proefschrift. Je bleef altijd nauw betrokken ondanks dat we elkaar vanwege soms twee of drie banen tegelijk niet altijd konden zien. Ook bedankt voor de vele persoonlijke gesprekken die we hebben gevoerd en onze gedeelde passie voor eten en drinken ;).

Dear Dr. Voigt-Radloff, dear Sebastian, thank you for all you hard work on collecting all the data in the REDALI-DEM study and enabling me to participate and make the study part of my PhD thesis. Although our contact was in general on distance, you were closely involved with my PhD project by challenging me with critical comments and motivating discussions. Many thanks for this good and pleasant corporation.

Dear Prof. Dr. Hüll, thank you for all your feedback on the REDALI-DEM papers. Your expertise was of great value.

Dear Dr. Leonhart, thank you for always answering my questions concerning analysis and the database and for you statistical contributions to some of the papers.

Dan zijn er nog veel meer mensen die mij de afgelopen jaren hebben ondersteund in dit promotietraject. Ilja, mijn kamergenoot vanaf dag één. In de loop van de jaren hebben we lief en leed met elkaar gedeeld. Ik heb bewondering voor jou dat je altijd voor anderen klaar staat.

Beste Sandra, bedankt voor alle wandelingen die we samen door de botanische tuin hebben gemaakt en de gesprekken die we hebben gevoerd. Ik vind het erg fijn dat ik altijd bij je terecht kan voor een luisterend oor en ik hoop dat er nog vele wandelingen zullen volgen.

Daarnaast wil ik ook mensen uit mijn naaste omgeving bedanken die hebben gezorgd voor de nodige ontspanning en daardoor ook zeker hebben bijgedragen aan de totstandkoming van dit proefschrift. Wendy en Gemma, bedankt voor de leuke 'spelletjes-avonden' van de afgelopen jaren. Het blijft bijzonder dat ondanks het feit dat we elkaar niet erg veel zien, het altijd zeer vertrouwd aanvoelt. De 'roeiploeg' en vroegere huisgenoten: Lianne, Eline, Dorien en Margo. Toen ik aan dit project begon woonde we nog samen in een huis, maar ook nadat we ieder onze eigen weg gingen bleven jullie erg betrokken. Bedankt voor jullie oprechtheid, humor en gedeelde voorliefde voor 'Kaapse pracht'. Arike en Kim, vriendinnen van het 'eerste uur'. Bedankt voor alle gezelligheid, goede gesprekken en kaasje, worstje, wijntjes. Dan de dames van S.V. 't Klootje: Hanneke, Josine, Karlijn, Vivian en Anoek. Alle borrelevenementen, feestjes en weekendjes weg doen mij altijd meer dan goed. Bedankt dat jullie altijd voor mij klaarstaan! Mijn paranimfen, Hanneke en Anoek, Ik vind het erg fijn dat jullie op de dag van de verdediging aan mijn zijde zullen staan.

Mijn schoonfamilie, Wilma, Paul, Jeroen, Irene, Bram, Lotte, Marieke en Robin. Bedankt voor alle interesse in mijn onderzoek en de gezelligheid. Dan wil ik nog mijn lieve zus Janneke bedanken dat ze er altijd voor mij is, ik ben super trots op jou! Tristan, erg bedankt voor alle heerlijke gerechten die je me de afgelopen jaren hebt voorgeschoteld.

Lieve pap en mam. Ik wil jullie bedanken voor alle ruimte die jullie me hebben gegeven om mezelf te ontwikkelen. Jullie hebben het mogelijk gemaakt dat ik ben gekomen waar ik nu ben. Bedankt ook voor alle fijne gesprekken, gezellige avonden en vakanties.

Lieve Erik, ik leerde je kennen aan het begin van dit traject. Bedankt voor het meeleven, geduld en het eeuwige vertrouwen dat je in me hebt.

Curriculum Vitae

Maartje de Werd was born on June 8, 1986 in Vlijmen, the Netherlands. After graduating from high school (VWO, d'Oultremontcollege, Drunen) in 2004, she started to study psychology at Radboud University in Nijmegen. In 2009 she received her Master of Science degree in neuropsychology (cum laude) from this university. In that same year she started to work as a neuropsychologist at the department of Medical Psychology at Radboudumc in Nijmegen. In January 2010, she also started (next to her work as neuropsychologist) as a research assistant at the Geriatrics department at Radboudumc in Nijmegen.

The errorless learning project started in 2011 and evolved in 2013 into a PhD project. In that year Maartje also started to work as a neuropsychologist at the department of Medical Psychology at the Viecuri hospital in Venlo. In October 2015 she started to work as a neuropsychologist at nursing home 'De Zorggroep' in Venlo, with the main focus on elderly with dementia. In January 2017 she started with the postdoctoral training program to become a registered healthcare psychologist at the department of Psychiatry at Radboudumc.

Maartje de Werd werd geboren op 8 juni 1986 te Vlijmen. Na haar middelbare school (VWO, d'Oultremontcollege, Drunen) startte ze met de studie psychologie aan de Radboud Universiteit in Nijmegen. In 2009 behaalde ze haar Master of Science (cum laude) met als afstudeerrichting neuro-en revalidatiepsychologie. Ze kon vervolgens direct aan de slag op de afdeling Medische Psychologie van het Radboudumc waar ze zich bezighield met het uitvoeren van (neuro)psychologisch onderzoek op de geheugenpoli en kliniek. In januari 2010 vulde ze deze functie aan met een functie als onderzoeksassistent, waar ze vragenlijsten en neuropsychologische screenings afnam bij kwetsbare ouderen.

In 2011 startte ze met het onderzoek naar foutloos leren, dat in 2013 werd uitgebreid tot een promotietraject. In dat jaar ging Maartje, naast het onderzoek, aan de slag als (neuro)psycholoog op de afdeling Medische Psychologie in het VieCuri Medisch Centrum in Venlo, waar zij hoofdzakelijk werkzaam was op de geheugenpoli. In oktober 2015 maakte ze de overstap naar zorginstelling De Zorggroep in Venlo waar ze als neuropsycholoog werkzaam was op diverse psychogeriatrische woningen en somatische afdelingen. Per 1 januari 2017 is zij gestart met de opleiding tot gezondheidszorgpsycholoog op de afdeling Psychiatrie van het Radboudumc.

List of publications

Journal articles

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De Werd, M. M. E., Boelen, D. H. E., Olde Rikkert, M. G. M., & Kessels, R. P. C (2015). Interrater reliability and concurrent validity of a new rating scale to assess the performance of everyday life tasks in dementia: the Core Elements Method. Poster presented at Finland, Tampere. Poster presentation at the Conference of the European Societies of Neuropsychology.

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ISBN 978-94-6284-110-9

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